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INDIAN SILKS

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The Journal of Indian Art and Industry.

THE SILK INDUSTRIES OF INDIA AND THE LIFE AND WORK OF SIR THOMAS WARDLE, J.P., F.C.S., F.G.S., &c.

The death of Sir Thomas Wardle of Leek affords an opportunity of once more drawing attention in the Journal to one of the most important and interesting Industries of India which no man, perhaps did more to promote and foster. The following are the principal articles of reference to the subject of "Silk" which have already appeared in it—No. 5. October 1884. "Thana Silks" is by Mr. B. A. Gupte, who states that the Industry is entirely confined to the Christian Community, numbering nearly 1,000 souls. Silks were made locally from A. D. 10 to 1260, and were probably brought from Persia and China. In 1583 there was a great traffic in Silk and Silk Cloths and in the sixteenth Century as many as 6,000 weavers were employed. The Industry was now much depressed. The special features of Thana Silks were of two classes, viz.—Silk with checked patterns which were, it appeared, of European origin, and others with graceful geometric and probably Saracenic designs. All the silk was bought raw in Bombay, and came chiefly from China, Bengal, Basra and Bokhara. The processes of weaving and dyeing are carefully described.

Good specimens of Kinkhab (*Kincob*) brocade, or cloth of gold, or silver, or both, and silk, were exhibited in the Bombay Court of the Colonial and Indian Exhibition of 1886. They came from Ahmedabad and Surat and were described in No. 11, the May Journal for that year.

In No. 15, Sir Thomas (then Mr.) Wardle, had an article on "The Indian Silk Culture Court," at the same Exhibition. He observed that in the previous year he was asked by the Government of India and the Royal Commission for the Colonial and Indian Exhibition to go out to India chiefly in the interest of Sericiculture in all its branches, which include the important and long established, but depressed Silk Industry of Bengal, the Tasar silk development of cocoons and raw silk, now happily a vigorous and settled European and American manufacturing industry which fifteen years ago was non-existent, and that of the other wild or semi-domesticated silks, such as the Eri, Muga, Atlas and Cricula trifenestrata, as well as others which are yet but little known to art or commerce in England. He was also to investigate the state of dyeing and printing fabrics in India; and to collect examples of Silks in all forms, for the Silk Culture Court of which he was the Honorary Superintendent, and of which he afterwards wrote his "Descriptive Catalogue," a work which he intended to be of permanent interest and reference. All these projects were successfully carried out as far as Sir Thomas was concerned.

He believed that there was a great future for Sericiculture in India and especially that the time would come "when the Silk manufacturing centres of Europe would desire the raw silks of Bengal as much as they now do those of China and Japan," because it was shewn that Bengal cocoons were capable of being reeled into raw silk of remarkable cleanness, regularity, fineness and elasticity.

Mr. Buck, (now Sir Edward) the Secretary to the Government of India, in the Revenue and Agricultural Department approved the suggestions of Mr. Wardle, for placing the Industry on a scientific basis. A Sericicultural laboratory was established at the Indian Museum, Calcutta, in which life studies of various species of Silkworms were conducted with a view to the production of the best cocoons, and therefore the amelioration of disease, breeding of the worms, growth of suitable food for them, and the introduction of better systems of reeling. Mr. Wardle, also gave an account of the manufactured and decorated silk of India which included the Corah (*Korah*) silks of Bengal, the coarse Tasar fabrics of the same and other districts, the magnificent Kinkhabs of Benares, Ahmedabad, Surat and Baroda, the plainer silks of Delhi, the delicate and beautiful silks of Thana, the ruder although not less interesting silks of Peshawar and the surrounding country, the satins of Azimgarh, Ahmedabad, Surat, Dhrangdhra and Kathiawar, the wonderfully constructed patterns of the Patolo weaving with "tie and dye" warp and woof, and the silks of Berhampur, Cambay, Cutch, Indore, Kathiawar and Bombay. These extensive but somewhat condensed extracts from the paper indicate the extreme wideness and interest of the Silk Industry and productions of India. The collection in the Silk Court was very comprehensive.

Much prominence was given to the embroidery of India which is on a great scale, to mixed fabrics such as the embroidered curtains of Dacca which were worked upon a cloth of cotton and Muga (*Antheræa Assama*) silk, to silk shawls from Burma and Pegu and to specimens from all the districts which have already been noted. He referred also to the indigenous methods of dyeing and to the dyes in use which he said were beautiful, and on which he subsequently prepared a valuable monograph. The Illustrations to the number are exceptionally fine.

No. 16, October 1886, Mr. B. A. Gupte, in describing the Baroda Court and its contents, refers to the Patolo silk, and suggests that the soil and climate of Baroda are well suited for the growth of Tasar silk and the nurture of the moths.

No. 18 of April 1887, is devoted to Embroidery by Mr. Gupte. He refers to the beautiful embroidery of Sindh on silk or cloth, and to the still better known work in silk and gold on scarves and the shawls of Kashmir as well as to cloths for which Delhi and the North of India are famous : to the use of so-called Dacca and floss silk and silver and gold wire in needle embroidery at Dacca ; and to Kalabattun or silk thread round which pure gold and silver wire, which is untarnishable, are twisted.

The Punjab silks and manufactures are described in several numbers. In Nos. 19, 20, 23 & 24, Vol. II., Mr. Kipling, in his review of the different districts, notes the gold and silk weaving of Multan and Bahawalpur, and similar belt weaving of Amritsar, the Kalabattun of Delhi—the use of silk in embroidery at the same capital and elsewhere, the small manufacture, particularly of Lungis or turban cloths, at Jalandhar, and he refers to Mr. Coldstream's interesting investigations with the Tasar moth which demonstrate the ease with which an important staple might be added to the products of the Sub-Himalayan tracts. An unattractive lack-lustre silk fabric is made at Lahore from raw material imported from Kabul. Multan produces a less cottony-looking silk than the other Punjab products.

Mr. H. C. Cookson, C. S., writes in No. 24 a monograph on the silk industry of the same Province which had declined since the establishment of British rule. Silkworm-rearing had been carried on in a desultory way, however in Kangra, Hoshiarpur, and Gurdaspur, but the silkworm is supposed not to be indigenous to the Punjab, but to have been imported from Kashmir or Central Asia, though the raw material now came from Bengal, China and Bokhara, Amritsar being the great home of the trade,

We shall see later on how Sir T. Wardle, was mainly instrumental in developing and improving the Silk supply of Kashmir. The demand for silk was however much less than in Sikh times, cotton goods having driven the richer material out of the field. The European liking for Phulkaris or "flowering work" had however, given a temporary stimulus to silk embroidery which forms the subject in No. 24, of an interesting article by Mrs. F. A. Steel, who observes that the ancient art was essentially a diapering and not a flowering in silk.

Mr. Havell in No. 27, who mentions that silk carpets were formally made at Tanjore and other adjacent places, refers to some beautiful satins which are manufactured at Ayyampet, Arcot, Walajánagar and at Ariyalur in the Trichinopoly district. Silk weaving and embroidery are also made in other places, but Madras on the whole does not appear to have much to do with silk.

Babu Nitya Gopal Mukerji, wrote on the Silk Industries of Murshedabad in No. 38 of April, 1892. He lamented the decay of the Industry which he attributed to the ignorance and poverty of the weavers ; to decline in taste and want of patronage ; and to decline in the Hindu religion which led to a diminution in the use of Berhampur silk, for it appears that the inland trade in it mainly rested upon the requirements of the Hindu ceremonial rites in which pure silk garments are needed.

The principal centres for silk manufacture in the district were Berhampur, Mirzapur, Khagra and Islampur, Babu Mukerji describes a large number of different fabrics, and the colors used in dyeing, as well as the processes of weaving and manufacture generally, in much detail.

In No. 59 of July, 1897, Babu N. N. Banerjee, the Assistant Director of Land Records and Agriculture in Bengal, wrote at length on the subject of Dyes and Dyeing in Bengal. He was very pessimistic as regards the silk dyeing industry in Bankura, Midnapore, Rajshahi, Bogra, Bhagalpur, and even in Murshedabad, all of which were Bengal districts, which he stated was now quite moribund owing to the decline in the Silk Industry itself ; indeed dyeing of all kinds had fallen off.

In No. 81, of January 1903, there are three articles on the silk fabrics respectively of the Bombay Presidency by Mr. S. M. Edwards, I.C.S., of the Central Provinces by Mr. F. Dewar, I.C.S., and of the Punjab, by Mr. W. M. Hailey, C.S. Mr. Edwards observes that to the Bombay Presidency the silkworm to-day is a complete stranger though attempts to rear it have been made in past years. The raw silk comes from China, Bengal, Persia and Bangalore. He describes the sorting, reeling and spinning, bleaching and dyeing, with the dyes ; warping and weaving and the finished fabric ; and illustrates his paper with an interesting series of drawings.

Mr. Dewar notes a similar condition of things to Bombay as prevailing in the Central Provinces. So far the mulberry Silkworm has not established itself but cloths and ornamental borders have for many years been made from imported silk from which he infers that an Industry has existed for at least one century, and probably for two in Berhampur and Nagpur.

The supply of raw material comes from China viâ Bombay and from Bengal viâ Mirzapur—amounting in 1867-8 to 228,862 lbs., half of which was Bengal silk.

At Nagpur and some other places the silk is usually worked up into womens' *saris* or veils, or into silk fringes for *dhotis* (waist bands) and saris of cotton, which are distributed all over the Mahratta country.

Gold and silver wire are interwoven with silk into extremely ornamental fabrics, as scarves or mandils, at Burhampur. The silk population of Nagpur in 1901, was little less than 12,000, showing the most prosperous period of the Industry in recent times. Mr. Dewar's account of Tasar Silk is full and interesting. The worm is found in the jungles of almost every district. There is a fairly strong demand locally for Tasar products but Mr. Dewar thinks the Industry is decaying chiefly because the supply of cocoons is failing.

Mr. Hailey in his paper on Silk in the Punjab, shews that there are no 'Wild' silkworms in the province which are commonly recognised as those of chief economic value, but consistent efforts have been made to domesticate the Bombyx Mori, or Chinese silkworm, and the fact that its food, the mulberry, flourishes and the temperature of some parts of the country is favourable, led to the hope that success would follow. So far however the amount of silk rearing is small. Mr. Hailey, states that the quantity of imported raw silk shows a tendency to increase. He describes the process of manufacture, notes the seats of it, and remarks that embroidery is probably done in every district. He thinks that the increased use is due to a more general diffusion of wealth amongst people who do not object to use mixed fabrics and he does not consider the change to be unsatisfactory.

In No. 82, April 1903, Mr. J. P. Hardiman, I.C.S., writes on silk in Burma.

Three specimens of worms are alone of sufficient importance in regard to the supply of silk to be worth rearing, these are :—(1) The Bombyx Arracanensis, or a species of the Bombyx Mori. (2) The Cricula Trifenestrata or Mango Silkworm and (3) The Attacus Atlas (Linn) so well known for its great size. He describes the processes of manufacture but has no account of the uses to which the silk is put. His paper is illustrated by interesting pictures drawn by native artists, amongst which are representations of the fabrics.

The great importance of the Silk Industry to India is also proved by the fact that in Sir George Watt's Official Catalogue of Indian Art at Delhi in 1903, no fewer than 49 pages, viz: from 289 to 338, are entirely devoted to the subject; besides which there are many references to the use of the material such as under embroidery and mixed fabrics—and silk and cotton which are made chiefly for the use of Mohamedans who should not wear pur silk in ceremonials. All who wish to make a complete study of silk should study this catalogue and the accountse in the Imperial Dictionary.

Sir G. Watt has several references to the beauty of Sir T. Wardle's illustrations in the Journal of Indian Art.

Babu T. N. Mukharji, F.I.S., of the Indian Museum, Calcutta, in his "Art Manufactures of India" (1888), devotes 16 pages specially to silk and silk fabrics.

The following quotation from his book is of importance. "Under the East India Company, large quantities of Mulberry Silk were produced, chiefly in Bengal, and exported to Europe. The Industry gradually declined since the abolition of the Company's filatures; and only a few years ago it was in an extremely deplorable state, owing it is said, to the deterioration which Bengal silk has undergone in quality of late years. The Government of India were making strenuous efforts to revive the trade by removing the causes of its decline, and if it ever goes back to its former prosperous condition, India will have a lasting debt of gratitude to Mr. Thomas Wardle of Leek, Staffordshire, for the great exertions he has made in this direction."

PERSONAL HISTORY OF SIR T. WARDLE.

Having given some idea of the nature of the subject, of which the present number of the Journal treats, we may devote a few columns to the history of the man, with whose name in recent days it has been so inseparably connected, and then go on in some detail to show the part he took in developing the Silk Industry in India.

The compiler of this account, for he can lay no claim to any other title in connection with it, began his friendship with Sir Thomas Wardle, when he met him in India for the first time in 1885, and has since then frequently visited him in his two homes in Staffordshire.

He has therefore had ample opportunities of seeing one whom he thinks all must regard as an excellent representative of the best type of the English Manufacturer and citizen.

He was not only a keen and successful business man, but a large-minded lover of his fellow men, who wished to extend to all the subjects of the King those advantages which he himself enjoyed. It was no mere business profit which induced him to devote so much time and money—often to his great personal loss—to the development of the Silk Industry at home and abroad. He saw and sympathised with the people of those large manufacturing districts of England which had suffered most acutely from the rapid decline of the Industry in England and its transfer under adverse conditions, to other countries, but he had equal regard for the losses which for various reasons, had fallen upon our fellow subjects in India in connection with the decay of the trade and craft in that country. He believed that India could give what England needed to the great benefit of both countries. He thought that, if scientific methods were brought to bear on the cultivation of the silkworm and the preparation of the silk in India, the Dominion could supply the greater part, if not all, the raw material which England required. Indeed he was so enthusiastic that he assured his friends that he believed the increased revenue and prosperity to be derived in India from a revived silk cultivation and industry would be sufficient to recoup the losses, which he foresaw, would follow the repeal of the regulations connected with the cultivation of Opium in that country.

His labours as President of the Silk Association of Great Britain will be adverted to later on, and it will be shewn that he did much to carry out his ideas in connection with the Industry in England. His even wider projects in relation to India form the principal reason for the publication of the present number of the Journal.

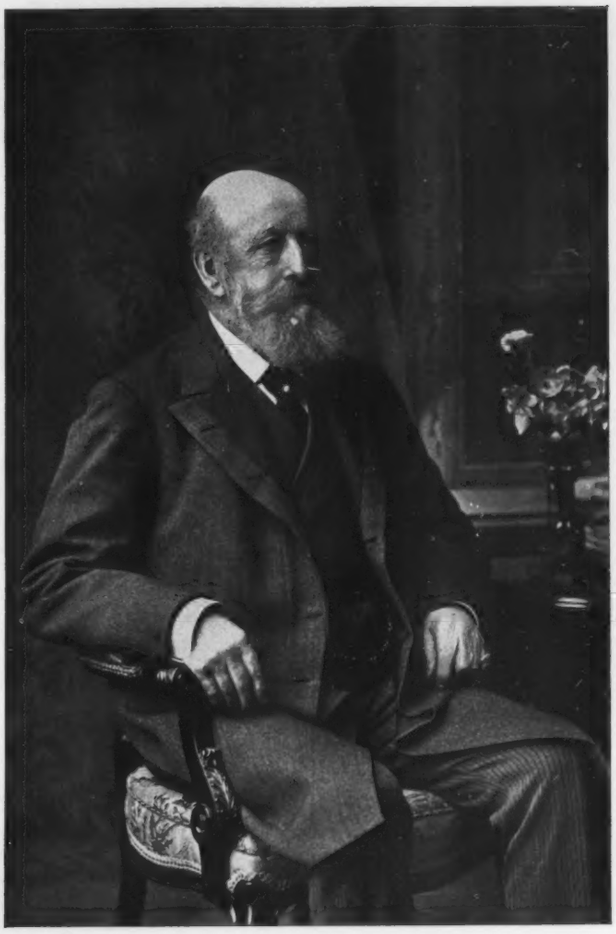
The brief Memoir which has been kindly written by his son, Mr. G. C. Wardle, narrates the principal events in his useful life, and also gives a short account of the work of Lady Wardle, who was equally enthusiastic, in the beautiful branch of Embroidery, in developing the uses of silk, and especially in making known in Europe the charm of Indian designs and their adaptability to various purposes both in the West and in the East.

The Memoir shows how a man who makes the very utmost of his own particular business in life can yet be keenly alive to many other interests and can serve his King and country in them all. Moreover we learn from it that Sir Thomas Wardle was a fine sportsman and a lover of all country pursuits, a good musician and a man holding strong views as to the greatness of the Empire, and the necessity of unity of all parts of it.

He collected almost everything, and every object he acquired was valued, and had peculiar interest to him. It is not wonderful then that he had many friends in his own neighbourhood as well as in all parts of the country and the empire which he had visited. His death has therefore left a gap which it will be difficult to fill, not only to his friends who recall the memory of one whom to have known was a real gain and pleasure but to many who only knew him by his works.

MEMOIR OF SIR THOMAS WARDLE.

SIR THOMAS WARDLE, F.C.S., F.G.S., &c., and Justice of the Peace for Staffordshire, was born at Macclesfield on January 26th, 1831. He was the eldest son of Mr. Joshua Wardle of Cheddleton Heath near Leek who founded the Silk Dye Works of Joshua Wardle & Son, at Leek Brook, when Sir Thomas was scarcely a year old. Educated at Macclesfield and Leek he entered his father's business and his early energies soon bore fruit in the well-being of the firm. His efforts in life were not destined to be restricted to one particular channel, for soon after the death of his father he brought into being the Silk and Cotton printing business of Wardle & Co., at Hencroft, Leek, where most beautiful and artistic work in block printing was carried on. One of the most interesting features of Sir Thomas' life was his association with Mr. William Morris who encouraged him in the artistic side of his business career and with whom for many years he enjoyed the closest friendship. No doubt Morris was instrumental in stimulating Sir Thomas in the production of the earliest Morris prints on Cretonnes and Silk so well known in England; Morris on one of his visits to Leek actually worked at Hencroft works with his own hands to produce certain colours so suitable to his particular



designs and Mr. J. O. Nicholson of Macclesfield, was entrusted with the weaving of the silk portion of these trials, some of which were dyed with pure Indigo from the vat. Later on Sir Thomas printed and dyed silk pieces for Mr. Liberty and finished them at his other works in Leek, (Churnet Works) and in the perfecting of this branch he was ably assisted by his son Mr. A. H. Wardle.

The most wonderful trait in Sir Thomas' character was the work he managed to get through apart from his real business, for he found spare moments when work was done to enrich his mind in many other matters. He was a keen student of Chemistry, Geology and Archæology and later on of Sericiculture, and his tastes ranged over an even wider field. Looking on his lighter side he was fond of music, more especially Church music, and his love for it dates back to his earliest days and from the time when he trained the Cheddleton Choir and played the Organ in that Church. He was always closely drawn to the Church especially in relation to music and adornment, and it is not too much to suppose that the study of Archæology and also stained glass was responsible to some extent for creating associations and friendship that so much influenced his later life.

In the year 1857 he married Elizabeth, daughter of Hugh Wardle of Leek, and in her he possessed one of the best of women, always ready to aid in times of need and with a power of organization not often met with. Lady Wardle was practical in a high degree and was a truly fitting helpmate. She was gifted with an artistic temperament and consequently was able to render her husband much help through life in the artistic part of his business. It was on account of her love for artistic needlework and their united interest in the Church that they together founded the Leek School of Embroidery where most tasteful and original work in both design and colour was done; the designs on Tasar Silk fabrics, the wild Silk of India, and the subsequent embroidering with the Tasar Silk threads, producing exceedingly rich and artistic work. Lady Wardle died on the 8th Dec., 1902. The late Vicar of Leek, the Rev. T. H. B. Fearon, speaks of her in a sermon following her death as follows :— "She sought and very largely found perfection in the art of sacred embroidery and lavished it upon the Church. I said that the heavenly life would be an active and a busy life. That is just what her earthly life was." Perhaps one of her most notable achievements was the reproduction (a perfect copy) of the celebrated Bayeux tapestry, embroidered scenes and figures upon cloth, and in this she was assisted by many ladies of Leek and district. The work now helps to adorn the Art Gallery and Museum at Reading.

The first dealing Sir Thomas had with Indian products was the trial he made, at the instigation of Sir George Birdwood, to utilize Tasar silk, the wild silk of India, and to make it a marketable commodity. As a result of his experiments he succeeded in bleaching the brown fibre and in dyeing it with such perfection, as to make it serviceable in the manufacture of fabrics. He tried the effect of Tasar as a pile fabric, and in 1872 he had a piece of Tasar plush woven in Crefeld. The idea was speedily taken up in Yorkshire and an article was manufactured successfully in that county under the name of Seal-cloth. For several years a Wardle collection of bleached and dyed Tasar silks was on exhibition at Lyons and Sir Thomas soon came into close association with the principal users of silk in France, and the results of his experiments in overcoming the difficulty of bleaching and dyeing this stubborn silk were, at the request of H.R.H. The Prince of Wales (now King Edward VII), exhibited in the British section of the 1878 Paris Exhibition, of which His Royal Highness was President. Sir Thomas became a juror at this International Exhibition and had the honour to be appointed a Chevalier of the Legion of Honour.

At the instigation of Sir George Birdwood, the Secretary of State in the year 1885 sent Sir Thomas Wardle out to India in order to make a typical collection of silk textiles and native embroideries for the Silk Culture Court of the Colonial and Indian Exhibition, and he was also requested to visit the Bengal silk districts and to make a report on Sericiculture. Bengal silks at that time did not enjoy a very good character, for they had fallen into a low state from one cause and another. Sir Thomas read his report before Sir E. C. Buck and the leading merchants in Calcutta on January 8th, 1886, and as an outcome of the enquiry it was brought to light that 60 % of the silkworms died of preventable diseases and that the reeling from the cocoons in the filatures was very imperfect. It was on account of this finding that Sir Thomas recommended the sending of an educated Indian to the Government stations of Sericiculture in both Italy and France, in order to learn all that was necessary to ameliorate the conditions of things in Bengal. This trip to India proved to be one of lasting interest and pleasure to Mr. Wardle as he then was; he revelled in the Indian atmosphere, the manners and customs of the people charmed him, everything was so vastly different from the life he had been accustomed to and the climate did much to give him a new lease of life, for his health and strength at that period were not of the best.

In the year 1887 Sir Thomas accepted the position of Chairman to the Silk Section of the Manchester Jubilee Exhibition and, chiefly through his energies, a display of silk manufacturing processes from the reeling of cocoons onwards was exhibited. It was from this exhibition that the Silk Association of Great Britain and Ireland came into existence with Mr. Wardle as its president, and to this honorable post he was elected, without intermission, year after year, until his death in 1909.

It must not be supposed that Sir Thomas was a man of such means that he could afford to neglect his home affairs with impunity, and had it not been for his brother's assistance in many matters of business it would have been impossible for him to have spared the necessary time for his country.

During the year 1896 Lieut. Colonel Sir Adelbert Talbot, K.C.I.E., was appointed resident in Kashmir, and, as a result of his study of Sir Thomas' encouraging reports on the possibilities of Kashmir silks, he recommended H. H. The Maharaja of Kashmir to commence the Industry on a commercial basis and in a scientific and extensive manner. In 1897 Sir Thomas was requested to consult with Sir George Birdwood at the India Office on the subject, and subsequently he was sent to France and Italy to select the best races of silkworm eggs, and to acquire the very best reeling machinery as well as to find a suitable person to direct operations in Kashmir. Mr. C. B. Walton was appointed to this post and materially helped in carrying the undertaking to so

successful an issue. Sir Thomas always advocated that new eggs annually imported from Europe were vastly more beneficial to Kashmir than "Eggs of reproduction" from Kashmir, as it was quite impossible for the village Kashmiris to understand the use of the microscope in detecting pebrinised moths and eggs, and the various minutiæ of this special branch of the Industry are so completely understood and taught under the direction of the Government experts in Italy and France.

In the year 1897, at the instance of Lord Salisbury, he received from Her Majesty the Queen, the honour of Knighthood for the work he had given to India and the Silk Industry generally.

From the year 1897 the Sericiculture in Kashmir progressed and went ahead by leaps and bounds and in 1900 the output of Raw Silk was 57,921 lbs; in 1901 it increased to 90,648 lbs, and in 1902 it reached the very creditable figure of 135,221 lbs It was in 1903 that Sir Thomas again visited India and a Durbar was held in March of that year at the Palace of Jammu to welcome him and to hear what he had to say as to the method of the distribution of the raw silks in Europe. His Highness the Maharajah and his brother the late Sir Amar Singh were both present at this Durbar and listened with interest to Sir Thomas' impressions of his stay in the reeling districts of the South of France. Samples were shewn of raw silks of the French reeling and also some magnificent figured brocades woven by Messrs. Warner & Sons, of Spitalfields, made entirely from Kashmir silks. The Maharajah was pleased to acquiese in the suggestion that a piece should be presented to H.M. The Queen of England and another to H.R.H. The Princess of Wales, and Sir Thomas was asked to be the bearer of them. The mission was formed in due course and to quote his own words. "It was impossible not to be struck with the genuine satisfaction and pleasure evinced both by the Queen and the Princess of Wales on the reception of these beautiful silks."

At a conference held later Sir Thomas strongly advocated the commencement of silk weaving in the State and he was instructed, with the Maharaja's sanction, to send out from England the plant necessary for an initial factory, and the first instalment was 200 looms together with a young and capable weaver from Macclesfield to superintend the preliminary stages. Success proved to be in the wake of this venture and at the present time scientific weaving takes place daily at Srinagar.

Before coming to the conclusion of this biography it is necessary to refer to the many kindnesses met with by Sir Thomas when in Kashmir. The many friendships he had the pleasure of making, and the kind treatment he had the honour of receiving at the hands of H.H. The Maharajah of Jammu and Kashmir and his brother General Raja Sir Amar Singh, were never forgotten.

The Times says "Sir Thomas' most conspicuous service for his country was the work he did in helping to revive the Silk Culture Industry in the Valley of Kashmir. The Industry was of ancient standing but had fallen into decay, and it is not too much to say that had not Sir Walter Lawrence taken up this matter in his capacity as Settlement Officer of the State, the fate of the Sericiculture would have been sealed, consequently it was upon Sir George Birdwood's initiative that Sir Thomas Wardle went out to Kashmir as expert adviser to the Durbar. How innumerable difficulties were overcome and how a moribund Industry was placed upon a footing of prosperity is told in detail in Sir Thomas Wardle's "Kashmir and its new Silk Industry" (1904), in which he was able to state that Sericiculture, besides giving employment to large numbers of villagers in the "Happy Valley" brought the State Durbar a revenue of £90,000 to £100,000 a year."

One of the most important honours, and certainly the one that gave Sir Thomas one of his greatest pleasures in life, was his admission by the Worshipful Company of Weavers to the honorary freedom of the Weavers' Company on Feb. 3rd, 1903. The Certificate of admission was presented with a casket bearing the arms of this ancient institution and the motto "Weave truth with trust." He was then able to acquire the Freedom of the City of London and the two certificates now lie safely in the casket and we trust will long remain an heirloom in his family.

Sir Thomas wrote many monographs on the scientific and technical subjects that interested him. He added a learned chapter in the Geology of Leek and district to the first edition of the "History of Leek" by John Sleigh, published in the year 1862. His splendid collection of carboniferous limestone fossils he gave to the Nicholson Institute at Leek. Other works on Geology were:—"Geology of the Roches," Geology of Shuttlingslowe," "Geology of Mid-England." He also wrote on the technical aspects of artistic weaving and his monograph on "The present development of Silk power-loom weaving in France" was the outcome of a visit to Lyons in 1893 to investigate the subject. His works on Silk and the Silk Industry were most numerous the most important being "Report on the English Silk Industry," "Silk, its Entomology History and Manufacture," "History and growing utilizations of Tasar Silk," "The Wild Silks of India," "The Dyes and Tans of India," "The adulteration of Silk by Chemical weighting," "Kashmir, its new Silk Industry," Etc., and his last work was a monograph on the Divisibility of Silk Fibre published in 1908.

Perhaps the most pleasing duty is to emphasize his home life and one cannot do better than quote the words of John Bickerdyke, which appeared in the "Field" newspaper. January 9th, 1909.

"It was at his country house at Swainsley, which is built on a low buff among the dales of Staffordshire, sloping down to the river Manifold, that my friend was seen at his best. Here was a hall crammed full of trophies from India including a huge Bengal Tiger; here were reminences of Scotch fishing expeditions, a rack of many fly rods, drawers full of flies, a room devoted to chemical and microscopic work and a fine organ, the bellows of which—and this was characteristic of the man—were blown by water-power elevated from the Manifold by means of a hydraulic ram." "Days at Swainsley are joyful memories."

The above is endorsed by the editor who adds:—"The feelings of regret and admiration expressed by "John Bickerdyke" will be echoed by a wide circle of friends and acquaintances and his faithful sketches of life at Swainsley will bring many a happy memory to those with whom Sir Thomas Wardle was always delighted to share his sport."

Sir Thomas Wardle died peacefully at his Leek residence on January 3rd. last, in his 78th year, surviving his wife by seven years. He always lived a life of high pressure, he worked well, and played well, and it was doubtless in consequence of this judicious combination of the two that he was enabled to live a life of almost youthful activity. It was only six months from his death that the strain perceptibly told on him, and from that period he gradually sank and passed away. He was laid to rest in the pretty churchyard of Cheddleton and many old friends were present to pay their last tribute.

An account is appended of the origin, objects and work of the Silk Association of Great Britain and Ireland, together with an interesting memorandum compiled by Sir Thomas himself, setting out the steps taken by him to further the development of the Silk Industry in Kashmir and India.

FORMATION OF THE SILK ASSOCIATION OF GREAT BRITAIN AND IRELAND.

On the 21st October, 1887, in the Silk Section of the Royal Jubilee Exhibition, Manchester, a Conference was held for the promotion of the Silk Industries of the United Kingdom.

Sir Thomas (then Mr.) Wardle, Chairman of the Silk Section, presided, and among others present were Sir Joseph Lee, Sir W. Cunliffe-Brooks, Mr. W. Bromley-Davenport, M.P., and Mr. (now Sir Alfred) Bateman, of the Board of Trade. Sir J. Lee, in welcoming the Delegates to the Conference, said he ventured to hope that their deliberations might result in the formation of a Guild or Association for the purpose of stimulating a revival of the Silk Industry in the country. This idea originated with Lord Stanley of Preston (afterwards Lord Derby) who was at the time President of the Board of Trade, and who said:—"We feel very much at the Board of Trade that we need some central organization which would make us in touch with the Silk Industry of this country, for we know very well that our returns are very imperfect; we want instructing a good deal; we have much to tell such an Association, and we hope that one of the principal resolutions of this Conference in Manchester will be the appointment of a Silk Association."

His Lordship sent down Mr. A. E. Bateman of the Board of Trade to attend the Conference, who was much interested in the proceedings, and he framed the resolution which was passed and which was the birth of the Silk Association of Great Britain and Ireland.

The objects of the Association were formulated, and were as follows:—

(*a*) The promotion and maintenance of the Silk Industry of Great Britain and Ireland in all its branches.

(*b*) To encourage the production of Raw Silk in India and our Colonies.

(*c*) To collect and disseminate amongst its Members, useful information and statistics connected with or affecting manufacture and commerce in Silk

(*d*) To promote Technical, Commercial and Linguistic Education, and any necessary Parliamentary legislation and generally to assist in the expansion and development of the Trade.

(*e*) To do all such other lawful things as are incidental or conducive to the attainment of the above objects or any of them.

The Membership of the Association included Silk Manufacturers Merchants, Dyers and Finishers and others who were interested in promoting the welfare of the Silk Industry.

Sir Thomas Wardle was appointed President in 1887 at the Silk Conference, an office which he held uninterruptedly up to the time of his death. The Secretary, Mr. A. E. Piggott of Manchester, was also appointed at the same time and he still retains that office.

Council Meetings were fixed to be held twice a year in Manchester and the Annual Meeting and Dinner were always held in London in February during the time of the Silk Sales.

The Association issued Annual Reports of work done, and these contain some very interesting information.

The following notes touch on the main features of the work of the Silk Association since its formation :—

At the first General Meeting of Members held in London in 1888 it was thought that the most important lever to raise the efforts to success was to secure the preference of British and Irish ladies for silks of home manufacture, instead of going to the Continent for their requirements.

The outcome of this was the formation of the Ladies National Silk Association, and the first president was H.R.H. Princess Mary Adelaide, Duchess of Teck. On her death, the office of president was taken by her daughter, H.R.H. The Princess of Wales, who still holds that position.

Silk Exhibitions were held under the auspices of the Ladies' National Silk Association in 1890, at Lord Egerton's House, St. James's Square, London ; in 1894 at Stafford House, London, by permission of the Duke of Sutherland ; in 1895 at Stafford, and in 1900 at Earl's Court, all of which helped to draw the attention of the public to the fact that silks for dress and upholstery purposes could be as well, if not better, produced by British and Irish manufacturers, as by those of the Continent.

Technical Instruction in silk was also taken the greatest possible interest in by the Silk Association, and it was largely owing to the efforts of the Association that the important Municipal School of Technology was founded in Manchester.

Beneficial action was also taken with regard to the regulation of Railway Rates and Charges and also with regard to foreign Tariffs.

The reorganization of Sericiculture in Cyprus was one result of the Association's work, through the Colonial Secretary in 1890, when the President made an exhaustive report on Cyprus silks.

The energies of the Association were applied, and with success in obtaining for British manufacturers contracts for silk goods given out by the Admiralty and the War Office and also in enlisting Government sympathy in a proposed amendment of the Carriers' Act which unfairly burdens the carriage of silk goods.

In 1901 H.R.H. The Prince of Wales consented to become patron of the Association.

FRENCH SILK DUTIES.—In 1905 the Silk Association took steps with regard to the proposed increased tariff by the French Senate on silks entering France, which would, if adopted, have seriously affected the silk trade of this country, particularly the manufacturers of silk crape who did a large export trade with France. With the co-operation of the British Chamber of Commerce in Paris, and the Associated Chambers of Commerce of the United Kingdom, whose Conference at Liege in September, 1905, Sir Thomas Wardle attended on behalf of the Association ; the appeal was successful, and the tariff remained as before.

Sir Thomas is succeeded in the Office of President of the Silk Association by Mr. Joseph Boden, of Messrs. Kidd, Boden & Co., Manchester.

In addition to the useful purpose served by the Association of organizing the Silk Industry so that it can officially consult with and receive information from Government Departments and kindred Societies here and abroad, bringing influence to bear in various directions when the interests of the Industry are affected, it has also provided a means or inter-communication and combination between its members which did not previously exist and must operate for the advantage of all.

ON SERICICULTURE AND SILK WEAVING IN KASHMIR AND INDIA.

BY THE LATE SIR THOMAS WARDLE, F.C.S.; F.G.S., J.P.

28th October, 1907.

The possibility of systematic Sericiculture, or the production of Raw-Silk, in Kashmir was first suggested by me to the Government of India in 1891. I recommended to the Under Secretary of State for India that inasmuch as the Mulberry tree was not only indigenous but abundant in Kashmir, and that I considered the climate of Kashmir extremely favourable for the cultivation of the Silkworm, it would be of great importance to commence Sericicultural operations there on a sound basis, such as is so successfully and scientifically practised in Italy and France, and I predicted that it was very probable in a short time a large and remunerative Silk Industry might result.

It was especially necessary for me to emphasise this recommendation at that time because famine and disease were rife in Kashmir, and many people were dying for want of food and remunerative employment.

I stated to the Government of India that I had a deep conviction that the future of the Silk Industry would be of great importance, and that if the Maharaja of Kashmir thought favourably of the idea and would give it the necessary encouragement, Kashmir might become one of the most important centres of Sericiculture, and I asked for the co-operation of the Government of India in the matter.

The result of this recommendation was that the Government of India warmly took up the suggestion.

I visited the Government Schools of Padua in Italy, and Montpellier in France, where all that relates to the breeding and rearing of the Silkworm, the cultivation of the Mulberry and the reeling of cocoons, are taught on the most practical and scientific basis.

Experimental work was carried on in Kashmir in 1894, and about 8 lbs. of raw-silk were produced and sent over to England, which I caused to be manufactured into brocade by Messrs. Warner & Sons, Silk Manufacturers of Spitalfields

The brocades were exhibited at the National Silk Textile Exhibition held at Stafford House, the London residence of the Duke of Sutherland. These were the first fabrics made of Silk produced in Kashmir.

In July 1895, some further samples of Kashmir raw-silk were brought over to London on behalf of the Kashmir Durbar, and were sent to me for a report as to quality, etc.

I reported on the 5th December, 1895, and advised that the stock of raw-silk should be shipped direct to London.

16 Cases were despatched, and these were received in London on the 26th January, 1896.

During the year 1896 Lieut-Colonel Sir Adelbert Talbot, K.C.I.E., was appointed Resident in Kashmir, and as a result of his study of my encouraging reports on the possibilities of Kashmir Silk, he recommended H.H. the Maharaja of Kashmir to commence the Industry on a commercial scale, and in a scientific and extensive manner.

The Kashmir State Council accepted Sir Adelbert Talbot's advice, and the Government of India was addressed accordingly.

The result was that in February 1897, I received a communication from the Under Secretary of State for India with reference to the further development of Sericiculture in Kashmir, and I was requested to have a consultation with Sir George Birdwood at the India Office on the subject.

The outcome of this was that I was sent by the Government of India in June, 1897, to the South of France and Italy to select the best races of silkworm eggs, to purchase the best machinery for reeling cocoons, and also to endeavour to find a suitable person (either a Frenchman or an Italian) who could direct Sericicultural operations in Kashmir. I endeavoured to find such a person, but was not able to do so, and I reported to the India Office that I preferred to decline the responsibility of engaging either a Frenchman or an Italian, chiefly because none of them understood either English or Hindustani, and also that I was not personally acquainted with any likely persons; but I recommended instead Mr. C. B. Walton, who had for twenty years occupied important expert positions at the Surdah Silk Filature in Bengal, and who was familiar with the language. He was at the time open to engagement, having retired from the Directorship of the Bengal Filatures, and the Under Secretary of State for India requested me to telegraph to him at once to go up to Srinagar to see Sir Adelbert Talbot, on whose advice the Kashmir Durbar gave him the appointment. The selection was a very fortunate one, for much of the marvellous success which has since attended Kashmir Sericiculture was due to his untiring labours.

During my visit to France and Italy in 1897, I purchased upwards of £600 worth of Silkworm eggs, and these, together with the cocoon reeling machines I bought in Italy were duly sent out to Kashmir. The hatching of the eggs and the rearing of the worms were most successful, and I was requested to purchase £1,500 worth for the ensuing season.

I did so, and the following year, 1899, £3,040 worth were purchased. In 1900 orders arrived for £4,000 worth, and in 1901 the same quantity was again ordered. Mr. Walton gave out the seed to 6,000 householders and they farmed it out, and altogether more than 25,000 people, young and old. were employed in rearing the crop of silkworms throughout the Valley of Kashmir. Thus the production of the Silk there is essentially a Cottage Industry as far as silkworm-rearing goes; but the reeling of the cocoons is entirely done in the factories in Srinagar, by Srinagar workman and boys, in the six new Filature Factories which were erected under Sir Adelbert Talbot's able supervision. Two Hibernation houses were also constructed, a necessary and important feature for the success of the Industry, as the silkworm eggs are there kept at a low temperature until the leaves of the Mulberry are ready for consumption by the worms,

I have always recommended the Government of India to adhere steadfastly to the purchasing of undiseased eggs from Europe, notwithstanding advice to the contrary by those who thought that "Eggs of reproduction" in Kashmir would do as well. Silkworm breeding and rearing in Europe is a very scientific Industry, and it was impossible to expect the village Kashmiris to understand the use of the microscope in detecting pebrinised moths and eggs, or in the various minutiæ of this branch of the Industry which is so completely understood and so skilfully taught under the direction and supervision of the Government experts of Italy and France.

But nearly every year since 1897, however, at my request, eggs of native reproduction have been tried experimentally in Kashmir on a small scale, and have always, through want of scientific oversight, failed. In 1904, the then Resident, Mr. Colvin, told me that it had been decided that the danger of using tainted seed could not be over estimated.

It will be seen how completely I was justified in making what was considered at the time, over adventurous purchases of eggs.

The value of the eggs ordered in 1902 was £4,084, and the same in 1903; in 1904, £4,960 worth was ordered; in 1905, £4,240 worth, and £3,840 worth in 1906; and a similar quantity this year. I am glad to be able to state that in each of these years the yield of cocoons has been most favourable and successful.

When Mr. Walton was appointed Director of Sericiculture in 1897, the out-turn of raw silk from the Kashmir State was for the preceding year only 10 to 12 maunds (820 to 984 lbs). In 1898 he had the first European seed purchased by me in Italy and France, in 1897, to work upon, and in 1899 the profit to the Kashmir State on the Sericicultural operations was £13,333. The raw silk sent to England in 1889-1900 was about 150 bales, or 22,500 lbs. which found purchasers at 16s. 9d. per lb.

Owing to the more trained manipulative skill on the part of the new cocoon-reelers, the quality of the raw silk was beginning to approximate to that of Italy and France, and would consequently command a higher price. In 1902 Mr. Walton sent over to England 953 maunds (74,186 lbs.) besides sending 100 maunds (8,200 lbs.) to the local markets for local use.

In 1900 I arranged a second exhibition of Kashmir raw and woven silks in the Silk Section of the Woman's Exhibition at Earl's Court, which was most successful and drew attention to this newly established Industry.

In 1903 I determined to go out to Kashmir to see how Sericicultural matters were going on. The Government of India approved of my going, and on the 13th March, 1903, a Durbar was held in the Palace at Jammu to welcome me, and to hear what I had to say on the various subjects connected with the silk Industry in Kashmir, and on the mode of distribution of raw-silk in Europe.

No balance sheet had been compiled for the years 1900-1903, so at my request the Accountant-General had one drawn up, which showed that there was the handsome profit to the State of £40,240 on the three years' working.

In May 1903, a Sericicultural Conference was held just before my return to England, and at that Conference I strongly advocated the commencement of Silk Weaving in the State, as I did not see why the natives there should not be taught how to weave such fine silks as are so largely imported into Europe and America from China and Japan; and in addition to that there was also the great field of silk-wearing India, with an extensive and important market close at hand. The Maharaja said he thought it was an excellent suggestion and that he should be very glad to see Silk Weaving introduced, as up to that time no Silk-weaving existed there.

On my return home I therefore got out plans for an initial factory and had 200 looms made and sent out. I also selected a young Macclesfield weaver as Superintendent of silk weaving. This branch is now well established, and should under good management, prove a successful one, and this I firmly believe will be the case. The Director has taught a number of Kashmiris to weave, and silk cloths similar to those exported from Japan to Europe are now beginning to be sent over in the grey for sale in London.

Mr. C. B. Walton, continued the Directorship of Sericiculture in Kashmir until September 1904, when he was invalided home, and to the great regret of all who knew him, he died on reaching England. Fortunately, he had left his son-in-law, Mr. Douglas, as Assistant Director during his absence, and he was appointed to succeed Mr. Walton as Director; this post he is in every way competent to fill, and still holds, directing the Industry very ably and successfully

The profit for the working of the Sericicultural Department for the year 1904 was £20,963, for 1905-6 £30,500 and will prove to be considerably more for 1907 and will again be substantially increased in out-put for 1907-8.

The crop of cocoons for 1907 is a record one, being no less than 28,000 maunds, equal to 1,100 tons.

The following table shows the gradual increase in the production of raw silk :—

Out-turn of Raw Silk for	1900	-	57,921	lbs.
,, ,, ,,	1901	-	90,648	,,
,, ,, ,,	1902	-	135,221	,,
,, ,, ,,	1903	-	146,087	,,
,, ,, ,,	1904	-	132,451	,,
,, ,, ,,	1905	-	152,425	,,
,, ,, ,,	1906	-	190,736	,,

There are now 10 large Reeling Factories at Srinagar, the capital of Kashmir. Each employs 560 men and boys in reeling cocoons. The number of Bassines, or reeling-basins is over 1,000, a most gratifying progress which has every promise of annual increase.

The number of village householders who now take out silkworm eggs is 15,784, and as their wives and children are occupied in feeding the silkworms and attending to the details of silkworm-rearing, their number, supposing four persons in each family assist in this industry, may be roughly estimated at between 60,000 and 70,000 persons in this new and remunerative industry.

A Sericicultural Branch has also been opened at Jammu under the Directorship of Mr. Fakir Chand, within the last few months.

At the Franco-British Exhibition, London, in 1908, the Kashmir Government sent a most effective Exhibit of cocoons, raw silk and woven silks. The Jury, in making their Awards, evinced much interest in these products and awarded the Grand Prix to the Kashmir Government for the Exhibit, together with a Gold Medal for the Director of Sericiculture and a Silver Medal for the Assistant Director.

THE BENGAL SILK INDUSTRY.

I will now turn to the Silk Industry of another part of India for the purpose of comparison with that of Kashmir.

In the years 1885-6 I was sent out to India by the Government to report on the Silk Industry of Bengal, which was then in an unsatisfactory and decadent condition. Since the time of the East India Company, this Industry had been a very important one in extensive districts of which Surdah and Berhampur were then central points.

I reported to the Government of India that I found upwards of 60 °/₀ of the silkworms died of disease before making their cocoons, owing to want of scientific knowledge and management. I recommended the engagement of some person who should first come to Europe to study the Sericicultural methods of France and Italy, and then for an Imperial Government Institution to be established there, where every branch of scientific Sericiculture could be conducted and taught to the Natives; in fact a Government Silk School, either in Calcutta or other likely centre, with highly qualified Teachers to instruct them how to prevent disease, to annually improve the races of silkworms and the growth of the mulberry.

A young Brahmin, Nitya Gopal Mukerji, was sent over to Europe by Sir E. C. Buck, Secretary to the Revenue and Agricultural Department, and he studied first at Padua, then at Montpellier, and lastly at Paris under Pasteur, who had succeeded in stamping out the pebrine and other silkworm diseases which had devastated for a time the magnaneries* of France and Italy.

* Places for rearing silkworms (French).

Nitya Gopal Mukerji returned to Bengal and was appointed to undertake the work of scientific Instructor

This arrangement was commenced and continued for a time, when, owing to difficulties and disagreements with his Committee, his instruction and work unfortunately ceased.

It was a pity and a mistake that an Englishman had not been technically educated for the duty. From that time to the present Sericiculture in Bengal has gone from bad to worse, until at the present moment the Industry is stated to be in a moribund condition.

It is sad to think that a valuable Industry extending, at its best period, over hundreds of square miles in Bengal, of which Berhampur was the centre, should have fallen into such a deplorable condition.

All the causes which have led to this are strictly preventable by, first, the proper growing of the best kind of mulberry leaves. In Europe the white mulberry produces the best silk ; in Bengal the Morus indica is used, but the botanical aspect should be well and continuously studied as is the case in the Government Sericicultural establishments for Italy at Padua, and for France at Montpellier. Secondly, thoroughly scientific rearing of the silkworm and the constant use of the microscope in the examination of all the female moths set aside for breeding purposes, and the absolute elimination and destruction of all eggs laid by those moths in which the pebrine corpuscle has been found.

Thirdly ; absolute cleanliness, ventilation of the magnaneries with thoroughly applied disinfectants, and regulation of temperature to prevent destruction by heat or cold waves.

4th, a study of race culture of moths so as to obtain the largest and best cocoons.

5th ; the purchase of eggs from districts set apart for breeding purposes, and away from the feeding and rearing centres.

This plan has admirably and abundantly succeeded in Kashmir, and there has been no failure since the system was inaugurated by myself, of buying eggs guaranteed free from disease, from Europe.

It would be of no avail in Bengal to purchase eggs from Europe as is the case in Kashmir, because the silkworms of Bengal are of a different and bivoltine species, namely, Bombyx fortunatus and Bombyx craesi, whilst those of Europe are the Bombyx mori which are suitable to the climate of Kashmir and not to the more tropical climate of Bengal.

In short, what is imperatively needed for Bengal Sericiculture is the adoption of European procedure in its entirety, the central idea of which is a Sericicultural Station strictly under the control of the Imperial Government as in France and Italy, and by no means under a local committee, with their ever-varying and conflicting ideas. It is a melancholy fact that what the committee is now aiming at might easily have been successfully accomplished 21 years ago, and the industry saved if my recommendations had been carried out.

These remarks apply equally to several other species of silkworms found in Southern India, such as Bombyx sinensis, Bombyx textor and Bombyx meridionalis, where extensive Sericicultural districts could be laid out for Silk production.

By way of contrast I now turn to another part of India where Sericiculture, now absent, could have enormous introduction and expansion.

On the 13th October, 1906, I wrote to the Government of India to suggest that as the mulberry was indigenous in many Valleys of the Punjab Terai, and as the Natives were in some parts destroying the trees and replacing them with other and more useful fruit trees, the subject of Sericiculture should be added to the Syllabus of Punjab Agriculture. I believe it has been, or is about to be, inserted.

That a similar development to that of Kashmir can be instituted successfully, but upon a vastly more extensive scale, I have not the slightest doubt whatever, and that European silk of the Bombyx mori can be cultivated not only in the Punjab but in the Terais of the regions east, west and north of the Punjab.

In Baluchistan it is already successfully established, although in a more experimental way. I have been consulted from time to time by Major Showers when he was Political Agent in Kalat, and since his departure from there by Major Rae Benn, who succeeded him.

TASAR SILK.

As is well known my study has been given to the production of Tasar Silk in India.

In 1878 the Prince of Wales (now King Edward VII.) President of the British Section of the Paris Exhibition of that year, had his attention drawn by Sir Philip Cunliffe-Owen to my researches on the dyeing and utilization of that wild Silk. H.R.H., requested me to exhibit my results in the Indian Section of that Exhibition. I did so, and as a Member of the Silk Jury, I had a good opportunity of directing the attention of the Lyons Members of that Jury to my discoveries in dyeing and printing this hitherto intractable Silk tinctorially, also in weaving it into various articles of commercial importance, principally plush.

The Lyons Manufacturers told me that they could see their way to a gradual utilization of this Silk. At that time none was used in Lyons or in Europe, but its usefulness was gradually increased and it is at the present time a most important and valuable European and American Industry.

The average amount during the last few months of Tasar raw silk conditioned weekly in Lyons is upwards of 300 bales (40,500 lbs.)

Now, unhappily, notwithstanding that the Tasar Silkworm is found nearly over the whole of India, the European demand has found its supply from China instead of from India, and I earnestly urge that adequate steps be taken to promote and increase the production of this silk in India.

The fashion in Europe has set in for cloths called Shantungs, which are made of Tasar silk, and many thousand pieces of native woven goods are being quarterly imported into Europe from China.

The results of my utilizations of Tasar silk are fully described and illustrated in my "Wild Silks of India" published in 1881 by the Lords of the Committee of Council on Education.

I visited the Tasar silk reeling districts of Chota Nagpur, Gya, Fatwah, and other Gangetic centres in 1886, and found several Industrial Tasar Silk centres, with women reeling the cocoons.

I read a paper on the subject on the 17th May, 1891 at the Society of Arts, London, when the late Lady Egerton of Tatton was in the Chair. In May 1895 I also read another paper at the Society of Arts on Silk when H.R.H. the late Duchess of Teck presided.

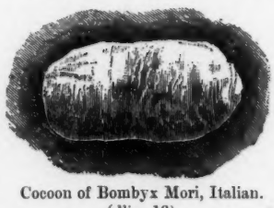
Owing to the want of energetic steps the Indian branch of this new important Industry has been almost non-progressive, whilst in China it has increased by leaps and bounds, both in the production of the raw-silk thread for weaving in Europe, and also in native woven Shantung cloth, the demand for which at the present time is very much greater than the Chinese supply, and therefore offers a great opportunity to India which ought to be vigorously taken hold of by capable oversight.

I have recently been informed by Mr. Rogers that there is a possibility of a successful culture of the Tasar Silkworm in the province of Gujarat, and also to the north of the Gulf of Cambay, and even as far as Rajputana. It would appear that the Presidency of Bombay is worth serious attention for the production of Tasar Silk.

Should it prove to be so, the labours of Colonel Coussmaker at Poona will not have been in vain. *

Sir Thomas Wardle has himself described in several publications the principal species of larvæ which produce silk. In a paper on Tasar silk which he read before the Society of Arts on May 14th, 1891, he states that "It is but a few years ago that it was thought there were only one or two kinds of silk, but in the Silk Culture Court of the Colonial and Indian Exhibition, upwards of 59 species of silk-producing worms were shewn with the silk they produced," and in the silk section of the Manchester Jubilee Exhibition he was able to show no fewer than 265 species of moths whose larvæ make cocoons. He showed how "all the species have the same instinctive object in covering themselves with this silken envelope, namely to protect themselves during that wonderful and all but lifeless pupa or chrysalide state, which in the mysterious arrangement of their lives, they have for a time to undergo. It is this silken chamber, which in the case of the Bombyx Mori, has for so many centuries been wound off into a continuous thread, dyed and woven into fabrics of such great charm, variety and utility in India and the further East." Sir Thomas thus briefly sums up the natural history of every kind of silk—"From a small egg laid by the moth, of whatever species, appears in due season a small larva or caterpillar, or worm, as it is usually called. This worm, after having lived its day, feeding only on the leaves of certain plants characteristic of its species, and increasing in size, spins or rather secretes, a fine silk thread for itself for covering and protection during the time it lies dormant in the next stage of its existence. As soon as it has secreted all the silk it changes into a pupa or chrysalis and remains inside its silken cell until the time for its appearance as an imago or perfect moth, having four scaly wings, six legs and two antennæ, which are larger in the male than in the female. When its hybernation is ended it emits a fluid which softens

½Larva of Bombyx Mori of Italy. (*Fig.* 4) †



Cocoon of Bombyx Mori, Italian. (*Fig.* 16)

* Some of the information given in this section has been anticipated in the earlier part of the Monograph, but it is thought better not to curtail Sir Thomas Wardle's own note.

† NOTE.—The numbers of the figures on this, and also the following pages, are taken from Sir T. Wardle's Work on the "History and growing utilizations of Tasar Silk," 1891.

the end of its cocoon cell, and by means of its wing-spines and legs, parts the fibres aside until the opening is large enough for it to creep out—after a short time its wings expand and dry, and it enters into its perfect state. It lives only a few days in this phase of its existence. It is in this stage only that the race is perpetuated, the female laying a number of eggs, and dying soon afterward." It is unnecessary in the present article to repeat in detail the information given by Sir Thomas Wardle. It will suffice to quote enough to explain the illustrations which have been reproduced by permission of his family from the original blocks which were used by himself—and first to describe briefly the ordinary silkworm of commerce, the Bombyx Mori, and then the principal ones in India, viz :- The Attacus Ricini or Eria worm ; the Attacus Atlas or Atlas worm ; the Antherœa Assama or Muga Worm ; and the Antherœa Mylitta or Tasar worm, with some reference to the A. Pernyi or Chinese Tasar worm.

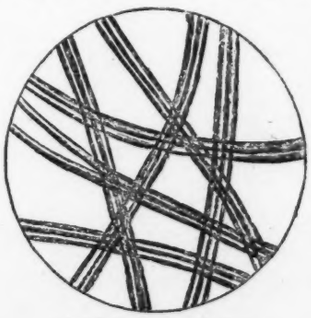
The silk producing insects belong to the order Lepidoptera and are all members of but two families, viz :- the Bombycidæ and Saturniidæ. All the latter are silk spinners, but not all the former. The Lepidopterous insects form order X of sub-class III. Metabola ; class VIII. Insecta ; sub-division II. Anthropoda (or true Articulata) : Division III. Articulata in the great system of classification of the Animal Kingdom.

Bombyx Mori, or Mulberry feeding Silkworm (male). (*Fig.* 1)

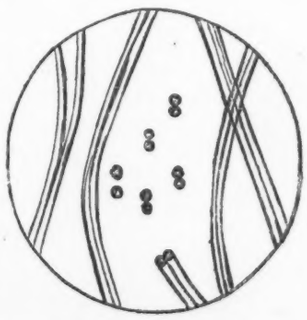
Bombyx Mori, (Linnæus) the common silkworm domesticated in China, Bokhara, Afghanistan, Kashmir, Persia, South Russia, Turkey, Egypt and Algeria, Italy, France and Spain, in all which countries it produces but one crop annually, spinning the largest cocoon, and the best silk of a golden yellow or white. The silk which is generally known as the silk of commerce, in both ancient and modern days, is distinguished from all others by the singular circumstance of the larvæ which produce it being fed only on the leaves of the Mulberry tree.

Bombyx Mori of Italy (male). (*Fig.* 2)

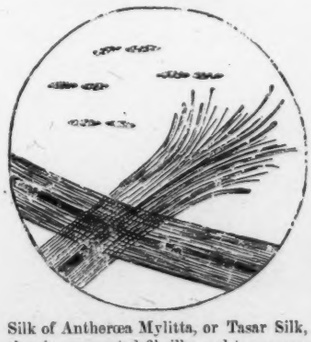
The breaking strength of a single fibre of Bombyx Mori (one 2,100th part of an inch thick in the mori silk of Italy) $2\frac{3}{8}$ drams against 7 drams in the case of Tasar silk. The fibre is round and homogeneous and resembles a glass rod, that being the characteristic and structureless form of the silk of all the Bombycidæ, whereas the family Saturniidæ produce silk of another structure. He observes that in all the Saturniidæ known to him the fibre is always more or less flat especially in Tasar silk, and possesses a structure not unlike the appearance of the warp-thread stretched in a loom before being woven. The width of this single or ultimate fibre of Tasar silk is about the 750th part of an inch, and in this narrow width there are about 20 smaller fibres or fibrillæ lying longitudinally and connected with each other by a hardened fluid seriposited at the time the worm forms this silken thread. The fibrillæ of the Chinese Tasar fibres are finer and rather more numerous than the Indian Tasar fibres. The value of the eggs of Bombyx Mori is about twenty-five shillings per ounce. Twelve pounds of cocoons are required to produce one pound of silk, and the value of the raw silk of Bengal in London is now (1881) from fourteen shillings to eighteen shillings per pound.



Fibres of Silk of Commerce, Bombyx Mori. (*Fig.* 11)



Silk of Bombyx Mori of Commerce, showing also transverse sections. (*Fig.* 12)



Silk of Antherœa Mylitta, or Tasar Silk, showing separated fibrillæ and transverse sections. (*Fig.* 14)

Attacus Ricini or Eria Worm.—The Eria silkworm feeds chiefly on the Palma Christi or Castor Oil plant (Ricinus Communis). It is a native of Assam and is also found in Nepal, Ladok, Chittagong, Puri, Gaya, Dinajpur, Rangpur, and perhaps in parts of Bhagalpur and Parnaih. In Assam it spins a white silk, whilst in Dinajpur the colour of the cocoon is brown.

The most complete account is probably the one written by Mr. Geoghegan, in his report on the Silk Industry of India.

Silk of Antherœa Pernyi, or Chinese Tasar Silk. (*Fig.* 15)

The following are a few statements made in regard to it. The female moth lays her eggs round a twig and then dies; these twigs are sold in the markets covered with eggs. The caterpillar moults four times and when fully grown is about $3\frac{1}{2}''$ long. It gives sometimes twelve broods of silk a year. It is difficult to reel, but the silk is better adapted for spinning. Mr. Lister (now Lord Masham) informed Sir T. Wardle, that Eria and Muga silk were to his mind far before Tasar. The former wrote "Abandon all ideas of reeling Eria silk, the cocoon is too soft, and the fibres mingled together too irregularly to afford any hope of successful reeling commercially. Produce it on a large scale, comb and spin it, and the success is complete." The cloth is described to be of incredible durability. The thickness of the fibre is one 1500th part of an inch on the outside of the cocoon and one 1450th in the inner part.

Dyeing Eria silk however is costly; whether owing to the flatness of its fibre or to the nature of its sericin (the gum or grès which encases the fibre as a varnish to preserve and protect it) it is far behind Mulberry silk in its natural affinity for dye stuffs, requiring about twice as much dye stuff as Mulberry silk. Sir Thomas Wardle was the first to impart a variety of colours to Eria silk which left nothing to be desired.

Attacus Atlas.—The imago or perfect moth of this species is the largest of all the silk moths. The largest specimens measure upward of 10″ in expanse of wing. It feeds on the Phyllanthus Emblica, the Falconeria insignia, Bradleia ovata, and other plants (in Mussoorie), the Barberry (in Kumaon) the Soom tree (Sarcostemma brevistigma) etc., and is a wide spread species, ranging over the South and East half of Asia, continental and insular, common on the slopes of the Himalayas, and all through India to the points of both peninsulas, etc., (P. H. Gosse in the Entomologist 1879) "It is interesting to observe the Micaceous or window-like spots on each of the four wings. These, although characteristic of the Saturniidæ, are almost more largely developed in the Attacus Atlas, than in any other species. The diameter of the external fibres of the cocoon is very variable, averaging about one 1320th part of an inch; whilst that of the internal fibres is more uniform and about 1000th part of inch. The outer fibres can support an average weight of $2\frac{1}{8}$ drams, and the inner $2\frac{1}{2}$ drams. The fibres are flat and longitudinally striated and united in pairs by the edges. The larvæ moult six times. The cocoon is from 2 to 3 inches long and about 1 inch wide at the widest part and weighes about one 14th of an ounce.

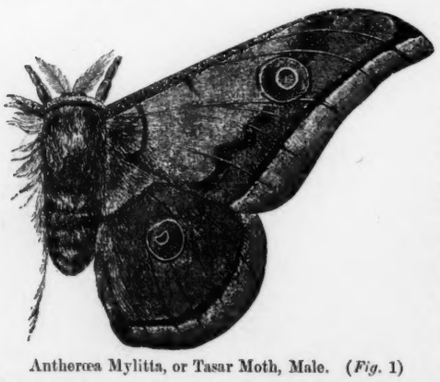
The cocoons are not closed like those of the Bombyx Mori or of the Antheræa, in consequence of which the exit of the imago leaves no disturbance behind. Mr. Geoghegan says the silk is difficult to reel. It is reputed to be decidedly good.

Antheræa Assama or Muga or Munga.—The worm feeds upon the Champa (Michelia, s.p.) the Soom (Sarcostemma brevistigma), the Tetranthœa diglottica; Laurus obtusifolia and the Tet. Macrophylla.

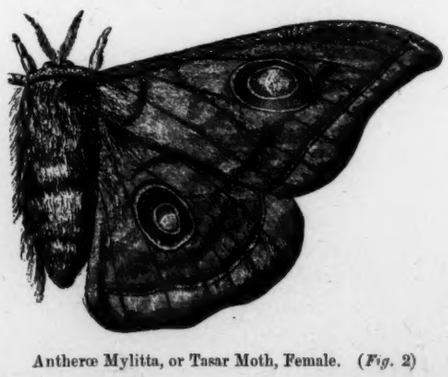
It is extensively cultivated by the natives, it can be reared in houses, but thrives best in the open air and upon the trees; it is found in Assam, and sparingly in the Dehra Dun, and is next in importance to Tasar.

The worm gives five broods a year, and the cocoon is very large but thin, the cycle of the insect is 66 days. The diameter of the fibres from the external part of the cocoon averages one 1,430th part of inch, and from the inner, which is less variable, one 1,080th part of inch. The outer fibres break with a weight of $2\frac{1}{8}$ drams, and the inner will support 3 drams. The staple produce from the Muga cocoon is excellent. The cocoon is larger and firmer than that of the Eria and can be reeled without difficulty. The silk is much better to dye than either Tasar or Eria, and it is done at a less cost. The spinning qualities (according to Messrs. Clayton Marsden & Co.,) of Eria and Muga are quite equal to any of the wild silks from China.

Antheræa Mylitta, Tasar.—The well known and valuable insects of this class (of various undetermined species) are widely distributed over India from East to West and North to South, on the coast and in the Central Provinces. They feed in a wild state upon the Ber (Zizyphus jujuba), the Asun (Terminalia Alata), the Semul (Bombax heptaphyllum, etc. This is the most important Indian wild silk. It has been utilised for many centuries both in India and China. The larvæ when fully grown, are about four inches in length; they have twelve joints or articulations, besides their extremities; their colour is green resembling the leaves on which they feed; and they are marked

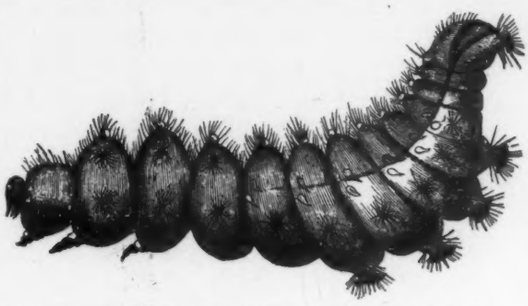


Antheræa Mylitta, or Tasar Moth, Male. (*Fig.* 1)



Antheræ Mylitta, or Tasar Moth, Female. (*Fig.* 2)

with reddish spots and a reddish yellow band running lengthways. Besides the trees above named they feed on many others which are well known, as the Teak (Tectona Grandis), the Sal (Shorea Robusta), Lagerstrœmia Indica, the Karinda (Carissa Carandas), the country Almond tree and the Castor Oil plant. In England they have even been fed on Oak leaves. The large number of plants on which they live accounts no doubt for their wide distribution. Birds and ants are the greatest enemies of the worms. The Caterpillars moult five times. The cocoons vary much in size, the largest being 2 inches long and $1\frac{1}{4}$ inches in diameter. The ordinary weight is 16 grains. As a rule there are two crops in a year. The cocoon is made of hard and impenetrable material. The fibre is almost flat and to this property no doubt Tasar owes its glossy or vitreous look. Sir T. Wardle thought that the lustre of the cloth woven from it was thereby enhanced.



Larvæ of Anthercea Mylitta, or Tasar Silkworm. (*Fig.* 27)

The diameter from edge to edge averages from the outer part of the cocoon one 770th part of an inch, and from deeper in the substance one 710th of an inch. The thickness from side to side is one 1,900th of an inch. The outside fibres can support an average weight of 7 drams and the inner, 8 drams. Like all other silk fibres, the fibres are laid in the cocoon by the silkworm in pairs, and are, like all flat silk fibres, united by their edges and not by their flat surfaces.

On May 14th, 1891, Sir T. Wardle read a paper (already referred to) on the history and growing utilizations of Tasar (Tussur) silk before the Society of Arts, in which he not only gave a full account of the silk itself, but he incidentally showed the great improvement and development of the Industry which followed upon his original researches and suggestions. It is desirable to condense some part of this account here.

There are two kinds of Tasar silk known to commerce, one Indian and the other Chinese, and in order to give as clear and complete account as possible, Sir Thomas Wardle spoke of both kinds. The Chinese moth (Anthercea Pernyi) has like the Indian moth four transparent wing spots, but they are much smaller and are not so transparent. The former differs from the latter much in appearance and colour. The Chinese worm is more insignificant than the Indian one, and it feeds on the Oak, there is much difference also between the cocoons.

Anthercea Pernyi, Male. (*Fig.* 8)

Tasar Cocoons with their Pedicals, showing natural attachment to branches. (*Fig.* 8)

Shows Cocoon cut open with Chrysalis inside. (*Fig.* 9)

The Indian cocoons are hard, well formed and very compact. They possess peduncular attachments with rings at the ends by which they are fastened to a branch or twig, a very necessary provision of nature, as the Tasar chrysalis requires months for its sleep.

The Chinese cocoon is soft and generally formed between two or three leaves of the Oak trees on which the worm feeds. It weighs from 8 to 9 grains. Chinese Tasar silk contains more sericin than Indian Tasar, and has a lesser percentage of silk than the latter. The former is generally loaded with saline and dirty extraneous matter, and the latter is always cleaner.

Chinese Tasar Cocoon, Anthercea Pernyi. (*Fig.* 10)

From time immemorial great difficulties presented themselves, especially in India, in dyeing Tasar silk. Forty-five years ago (that is before 1891), the father of Sir T. Wardle, one of the best English dyers, tried to overcome them but only with very partial success. His son continued the study until at last, with increasing acquaintance with the properties and structure of the fibre as well as a fuller knowledge of chemistry which aided him in the better application of tinctorial matter by chemical agencies he was able first to make greys of various kinds; then red, blues, and greens of not

very brilliant tones succeeded, and afterwards good yellows, pale shades of blues, reds and tertiary hues were produced. As soon as he had overcome the difficulties of dyeing this silk in the ordinary colours of the period, for it was before the introduction of aniline dyes, he was asked by the Marquis of Salisbury, then Secretary of State for India, to teach the Indians how to dye native wove Tasar cloth which was then used by English and French as well as by Indian women in the undyed state. It was far more difficult to dye the silk in the piece than in the skeins.

In placing his services at the disposal of Lord Salisbury, he suggested the desirability of the use in India of Indian dyes as the country was so rich in vegetable tinctorial products.

In accordance with his wishes, instructions were issued for the collection of all the well-known dye stuffs in India, and in due course a most valuable supply was sent to him for examination and report. It took him with an assistant, more than seven years to examine the materials. The result of that investigation was the issue of a Blue book of eighty-two pages, entitled "The Dyes and Tans of India."

In connection with this laborious work he prepared 360 sheets, containing about 3,500 dyed samples, illustrating the tinctorial results of 181 kinds of Indian dye stuffs, which show the tinctorial properties of all dyes commonly used in India.

Sir T. Wardle lamented that the usefulness of the work was counteracted by the facts, that owing to insufficient expenditure upon it, it did not contain the method by which he succeeded in obtaining the beautiful colours inserted in the book, nor were patterns included in it.

He concludes his remarks on this subject with the following interesting passage :—

"Since that time, for all art work, I have chiefly used Indian dyes, from which I succeed in obtaining results in tone and permanence absolutely impossible with most of the artificial dyes, good as some of them are, and if the Government of India had followed up my arduous work further and in a prompt and thorough way, I am sure Europe would now have been doing a large business in dyes with India, for all their *bon teint* purposes, and the Indian dyers themselves would have been able to make themselves acquainted with superior methods at present unknown to them. The way in which indigo, for example, still asserts itself is a sufficient proof. But it is not too late. As taste improves, the weaker dyes are more disliked, and I would from this place urge the Government of India to make the work so successfully begun by Lord Salisbury, complete. The Hindoo and Mohomedan dyers still remain untaught in the application of chemical science to their art, and the European dyers remain unaware of the excellence of scores of, to them, unknown Indian dyes."

The enthusiasm of Sir Thomas Wardle has induced many, both officials and others to work in the same good cause, but the difficulties in the way of introducing new methods, especially in the East, are enormous, and it is to be feared that no amount of zeal, or of official support, especially in the form of printed or even copiously illustrated reports and books, however widely circulated, will effect very rapid changes in the industrial processes of India. More could perhaps be done by the active practical work in India of half-a-dozen men of the same stamp as Sir Thomas Wardle, than by the issue of many publications. Let us hope that such men will arise amongst Indians themselves. Such men will find that a commercial and artistic career presents far more advantages than the present and more popular one, which leads only to official employment or even employment at the bar or in medicine and the like.

Sir Thomas Wardle investigated the subjects of Sericiculture and dyeing in India in 1885 and again at a later date.

In accordance with the instructions of Sir G. C. Buck, Secretary of Revenue and Agriculture, he visited the Bengal Sericicultural districts where the Bengal silk of commerce is produced, (the silk of the Bombyx fortunatus and Bombyx Crœsi). He was to report on the causes of their depressed condition and diminished output. This report was published by the department of Revenue and Agriculture and the following is a summary of his results. In some filatures he found very defective reeling, in all possibilities of improvement. In the cocoon-rearing villages there was much preventible disease, and generally about 60 per cent of the worms died from pebrine and other diseases.

The Indian women reeled and wound the silk in a dirty, toilsome and unhealthy way, as may be judged from the illustrations.

The introduction of such an appliance as the Tavelette Keller could remedy the defect of bad reeling.

Other difficulties, which were fully mentioned in the report, could be easily ameliorated by an Imperial bacteriological and educational effort, which he urged.

Mother and daughter: the daughter winding Burni or Weft from the hand-reel to small Shuttle Spools or Squills. (*Fig.* 31)

A station was afterwards established at Berhampur, which was directed by Mr. Nityal Gopal Mukharji, who was first sent to the Government Sericicultural establishments of Montpelier and Padua, after having studied the treatment of the various diseases at Paris under M. Pasteur. Much improvement in reeling was effected and the value of Bengal silk increased by upwards of three shillings per lb.

The compiler of this paper who in 1899 accompanied the late Sir John Woodburn, at the time Lieutenant Governor of Bengal, saw the work of the silk department in full and careful operation. He was most struck perhaps by the way in which the silkworms' eggs were all systematically examined with the microscope for the detection of disease.

Sir T. Wardle next went to the Santhal country in Central Bengal to enquire into the output of Tasar silk.

The Santals instead of cutting the pedicles of the cocoons and allowing the latter to drop, cut off the twigs with the cocoons, thus causing the trees to die. He showed the people how wasteful this procedure was and they promised reform. He found hundreds of square miles of forest in which abound the principal trees on which the Tasar moth feeds, and saw almost endless prospects of increasing the production of the valuable insects.

It appeared to him indeed that in India there was vastly more area for the cultivation of silk than for cotton, and he argued that so great was the demand for the former, a demand which was met chiefly by China, that it would be most desirable to meet it. The Rev. Mr. Campbell, with whom he stayed and who worked as a Missionary amongst the Santhalis was of opinion that the best plan to promote increased Tasar culture would be for some capitalist to take the forests and employ the people to collect the cocoons, conditionally that they did not lop the trees.

Fatwah Silk-women: Mother, Daughter and Daughter's Child; the mother reeling Tasar Cocoons. (*Fig.* 30)

He visited Gaya, Arrah and Fatwah, other centres of the Industry.

At Fatwah he saw the local weavers who were weaving cloths of Tasar silk warp and cotton weft. Here also were cocoon merchants who collected Tasar cocoons from the jungle villages and either sold them to reelers or employed women to reel them.

USES OF TASAR SILK.

THIS is not the place to record all the uses to which the ordinary silk of commerce is put, nor therefore to dwell upon the varieties of it which come from Bengal, but some account of the utilizations of Tasar silk, as summed up by Sir T. Wardle in his paper of June 12th, 1891, seems desirable. He drew particular attention to the beautiful pile fabrics, seal-floss, seal-cloth and sealette, of which he exhibited specimens, and which had been manufactured by Messrs. Norton Brothers & Co., Messrs. Joseph Walker & Sons, and Messrs. Field & Bottrill of Huddersfield and the neighbourhood. He said that nothing in any fibre had ever been made to exceed them, and that they were wonderfully rich, soft, and glossy.

TASAR EMBROIDERY SILK.

Tasar silk is more lustrous than Japan silk, but is not quite so lustrous as China silk. One of its successful uses is for embroidery. This applied use was first made by Mrs. (afterwards Lady) Wardle, under whose auspices many beautiful specimens have been worked by the Leek Embroidery Society. Many beautiful Indian designs have been reproduced at Leek by the Society with silks dyed with Indian dyes by Sir T. Wardle.

TAPESTRY CLOTHS AND CURTAIN STUFFS.—Tasar silk has been successfully substituted for ordinary silks for upholstery cloths or tapestry, as it is erroneously called.

TRIMMING MATERIALS.—Sir T. Wardle remarked that Tasar silk was superior to other silks for trimming purposes by reason of its natural lustre, cheapness, and greater resistance and firmness of pile. It is also used with success for silk handkerchiefs, dress silks, and damasks.

CARPETS AND RUGS.—Mr. William Morris designed and his firm made a hand-made carpet for him which was quite as lustrous as the Indian silk carpets, and had a better and firmer pile.

VELVETS, CURTAINS, AND SHAWLS.

Tasar is admirably suited for furniture velvet. It is more lustrous than Utrecht velvet, but not so soft as ordinary velvet.

INDIAN TASAR SILK.—This silk finds its greatest market and manufacturing use in France. China Raw Tasar silk is so badly reeled as to be fit only for the coarsest textiles, but since Sir T. Wardle was in India so much attention had been paid to the reeling of the Berhampore and Sardal and some other filatures that Indian raw silk can now be used successfully for artistic purposes by the best Lyonese manufacturers. He comments on their charming brocades, in which Tasar is used for the weft and cotton for the warp.

OPERA SHAWLS, LACE, AND ELASTIC WEBS OF TASAR IN ENGLAND, GERMANY, ETC.

Sir Thomas Wardle exhibited a large series of examples of printing upon native woven Indian Tasar silk to show what could be done with tinctorial matter, and in further proof of its value in this respect his son had dyed fourteen specimens to the shades of the principal precious stones. He was able to prove with these and the work of other dyers, both English and Continental, that the difficulties of dyeing Tasar silk had been entirely overcome.

The most recent information regarding the production of wild and cultivated silks in the British Colonies and Dependencies is probably contained in No. 2, Vol. VII., of the "Bulletin of the Imperial Institute." The writer refers to the attention which is being paid to the subject, notably in Uganda, British East Africa, and Ceylon, whilst in India steps are being taken to improve the methods of Tasar silkworm rearing. The last-mentioned industry being of considerable interest, he proceeds to give a short account of it, and especially of the improvements introduced recently.

The reader is referred to the "Bulletin" for full information, much of which, however, has already been given from other sources in the present article. The writer of the paper goes on to state, however, that: "From time to time the Bengal Government have endeavoured to foster the rearing of the Tasar silkworm, but in spite of this the industry has steadily declined in the Province. Sir George Watt has ascribed this decline to the successful supply by China of a cocoon suitable for the same purpose as Tasar, and to the cheaper manufactures of Europe. Recently, however, the Bengal Department of Agriculture decided to inaugurate Tasar silkworm-rearing experiments on model farms, and an account of the results obtained is given by the Deputy Director of Agriculture, Bengal, in a recent issue of the 'Indian Agriculturist.'"

These extracts from the "Bulletin" show the continued anxiety of the Bengal Government to develop the silk industry, and it is to be hoped that in the end the hopes of Sir Thomas Wardle himself may be fully realized.

In the introduction to his "Report on Dyes and Tans of India," which was published as a Blue Book in 1887 by the Government of India, Sir T. Wardle wrote as follows:—"The coloured results which form the illustrations to this examination will suffice, however, to show how rich India is in her dyes. I cannot help thinking that it is a misfortune that in publishing these results the Government of India cannot see its way to the expense of publishing coloured illustrations. Without them it is impossible to form an adequate conception of the beauty of the colours obtained, or of the peculiarity of the tones which, under certain methods, so many of them yield.

"I have no hesitation in affirming that these Indian dyes are well worth the attention of European dyers and printers as possessing properties distinct from, and in many cases superior to, the dyes obtained from artificial sources."

Reproduction of the coloured illustrations would not only have been very costly, but even with the best and most expensive methods known the results might have been misleading, because if exposed to light, and in some cases without that being done, in the course of years modern printing colours and tones change, sometimes very considerably, even in book illustration.

In this connection it seems of interest to show what has happened in Calcutta to some of Sir T. Wardle's own illustrations, of which 354 cards (each containing about ten specimens of coloured cotton, wool, silk, Eria and Tasar silk thread, or sample of dyed cloth) were placed in the Bengal Economic Museum under the instructions of the Government of India, when the report was issued about twenty-two years ago.

The "Agricultural Ledger," 1908, No. 2 (1909), is mainly devoted to "A Summary of our present Knowledge regarding the use of Dyes from Flowers in India," by I. H. Burkill. Mr. Burkill states that he has recently examined all Sir T. Wardle's samples which were placed in the Museum in 1886. He compared the present colours with Sir T. Wardle's descriptions. He remarks as follows:—"Most of the specimens have not been exposed to light, but have been left in large folios just as received; though others, since 1899 or 1900, have been exhibited in the diffuse but good light of the Economic Gallery of the Indian Museum .... Out of the long series which has not been exposed to light, tissues of Corah silk, Tasar, wool, and cotton dyed with Nyctanthes and Tūn (Cedrela Toona) flowers have faded much, often completely so .... Changes in other dyes are not generally detectable, but some deadening of the brilliance is to be expected in almost all. However, a sample of Corah silk dyed with Delphinium Zalil by one of Sir Thomas Wardle's processes, is still of brightness hardly to be excelled .... The samples which have been exposed to light are from three dyes only: Butea, Safflower, and Woodfordia. Butea shows some sign of fading in Corah silk and Tasar, but not much .... The duller colours of Woodfordia are perhaps a little faster to light; very few of the specimens in the Indian Museum show distinctly that they have faded .... The colours of Safflower have all faded more or less. The dye is of course known to be fugitive."

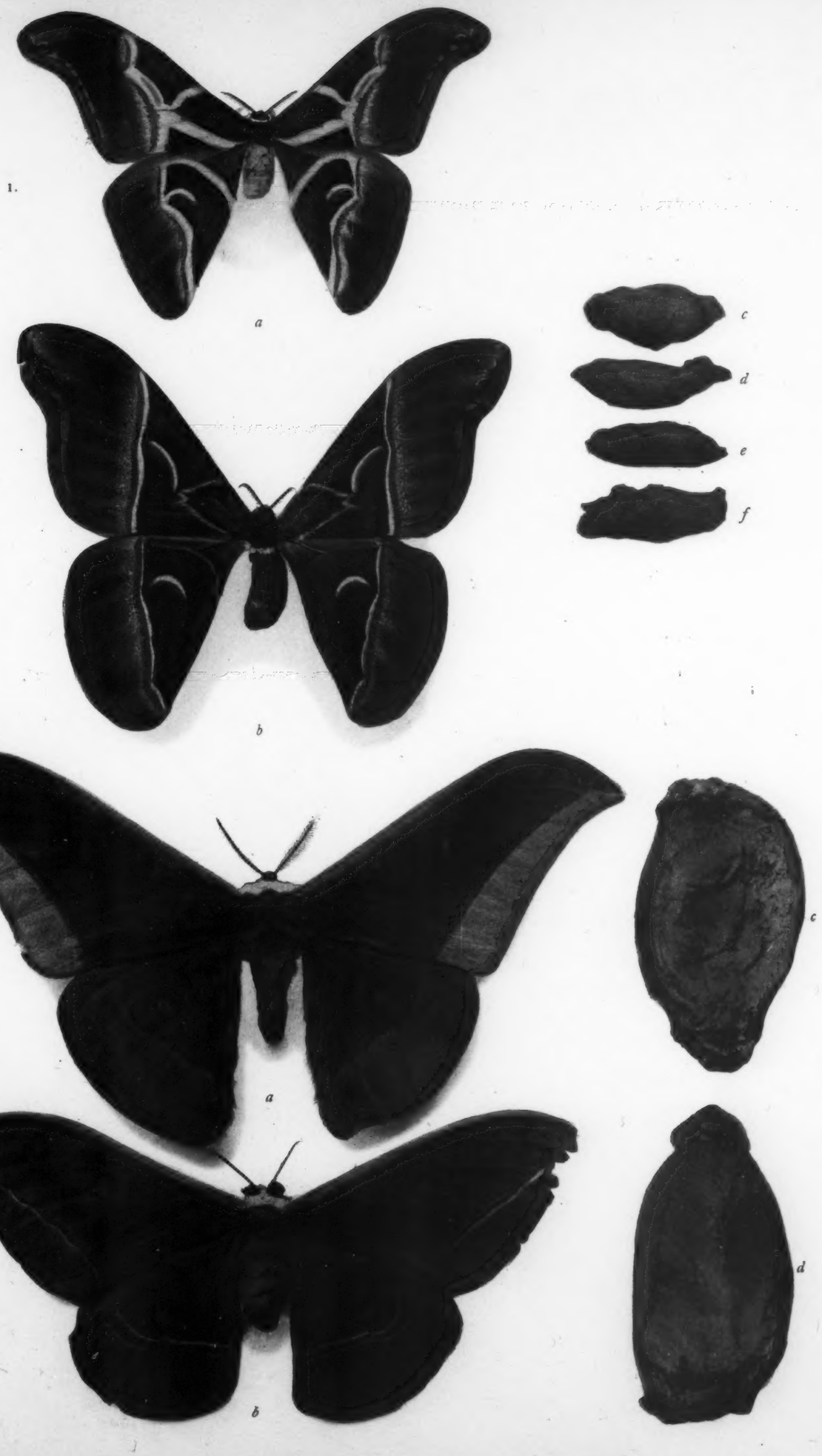
LIST OF ILLUSTRATIONS.

1, 2, 3. Moths, Cocoons, etc., (in colours). 4, 5. Silk Embroidery (in colours). 9. Silk Embroidery. 7, 8. Tasar Silk: Tapestries, Brocades and Fabrics. 9. Designs for Silk Fabrics. 10. Edward Street House and Swainsley. 11. Portrait of Major General H.H. Sir Pratap Singh, G.C.S.I., and his brother the late General, Raja, Sir Amar Singh, K.C.S.I., and palace at Srinagar. 12, 13 & 14. Illustrations of Silk Production, Filatures, Hibernation Houses, etc.

The coloured plates of Moths were copied by kind permission of the authorities, from specimens in the Natural History Museum at South Kensington. The textiles were copied from originals supplied by the Trustees of the late Sir Thomas Wardle, who were also good enough to allow the remaining illustrations to be reproduced from original works of Sir T. Wardle.

1.—1. Bombyx Mori. (*a*) Cocoon cut open. (*b*) Cocoon. (*c*) Eggs. (*d*) Pupa. (*e, f*) Cocoons denuded of rough exterior silk. (*g*) Skein of silk. (*h, j, k, e*) Moths. (*m, m*) Larvæ, or worms. 2. Antheræa Mylitta or Tasar Moth. (*a*) Male. (*b*) Female. (*c, d*) Tasar cocoons with their pedicles, showing natural attachment to branches. (*e*) Cocoon. (*f*) Cocoon cut open.

From the Natural History Museum, South Kensington. By permission.



2.–1. Attacus Ricini. (*a*) Male. (*b*) Female. (*c, d, e, f*) Cocoons. 2. Antheræa Assama or Muga Moth. (*a*) Male. (*b*) Female. (*c, d*) Cocoons.

From the Natural History Museum, South Kensington. By permission.

3.—Attacus Atlas. (*a*) Male. (*b*) Female. (*c*) Pupa. (*d*, *e*) Cocoons.

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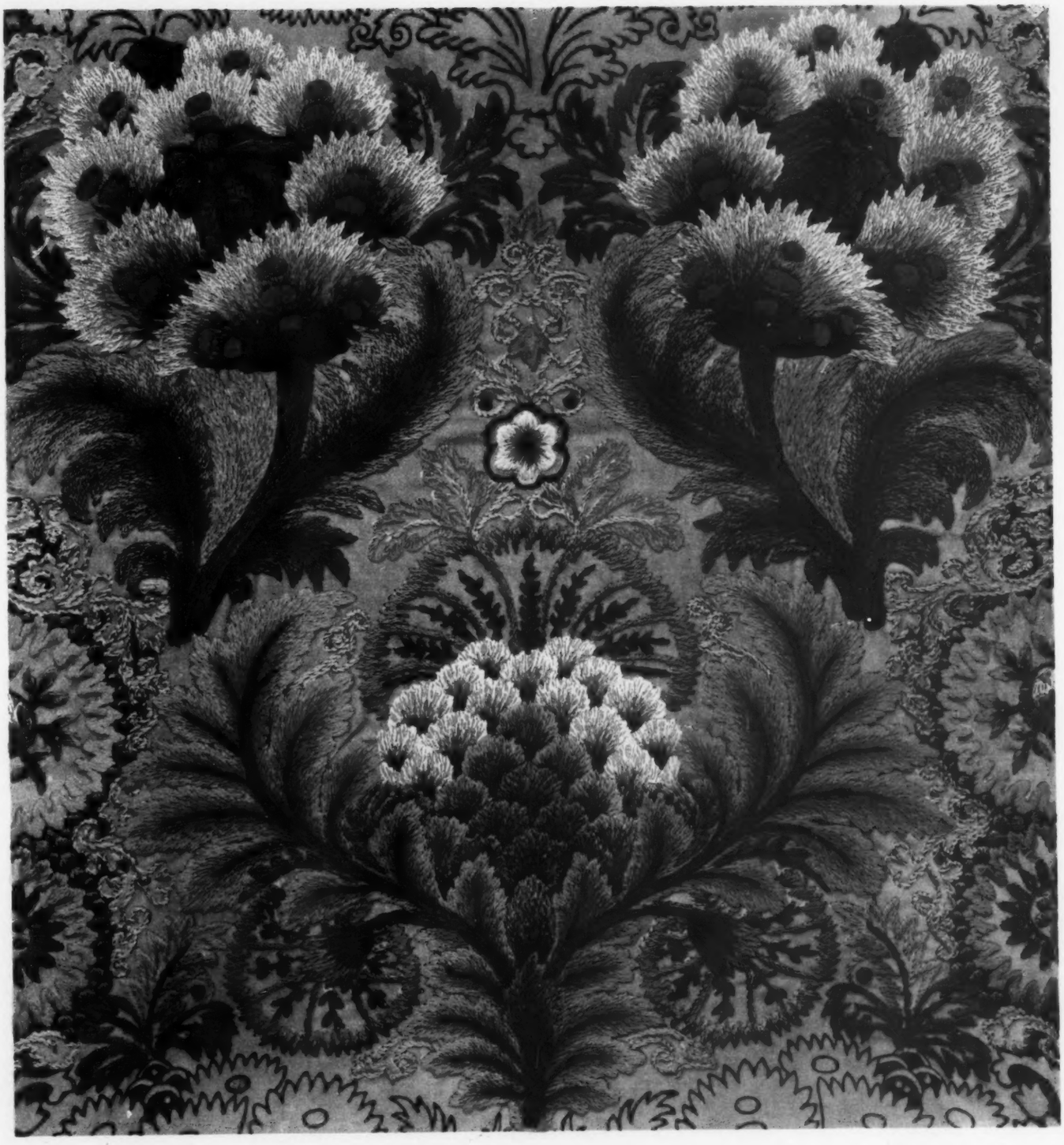


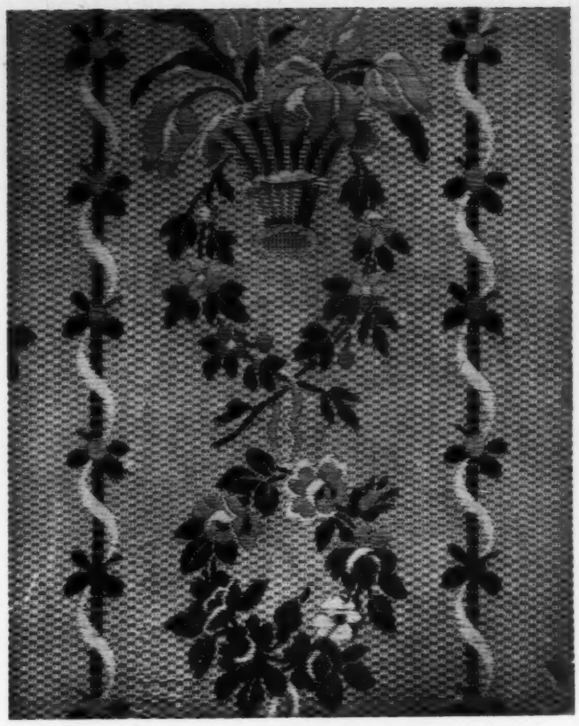
4.—"Indian Poppy."

A well-known Leek design.

5.—"DAMASCUS."

Design worked in Tasar Silk at the Leek Embroidery School.

6.—Design from a Fresco in the ancient Buddhist caves at Ajanta, Bombay Presidency. One of a series of beautiful designs taken from the caves by Sir T. Wardle. The best date, about the first or second Century, A.D.



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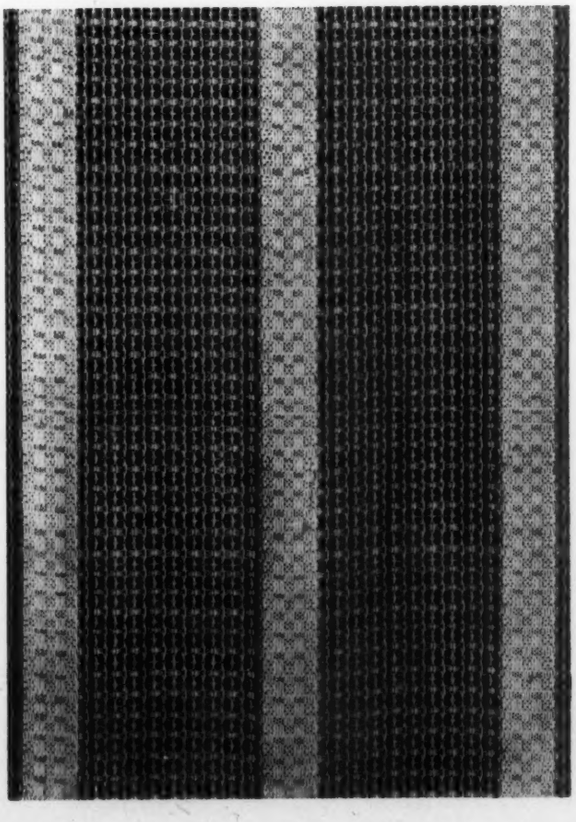

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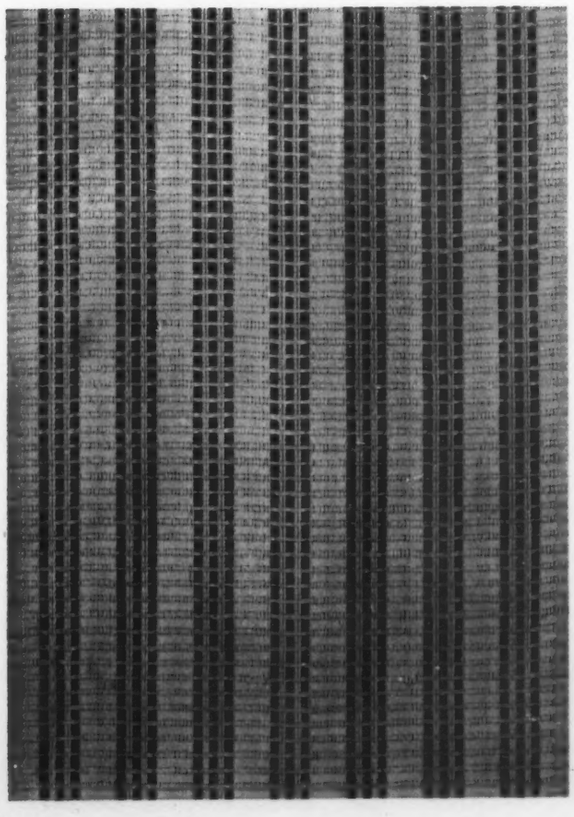

4

7.—1. Figured tapestry, woven with Tasar silk; "Indian Bombyx Mori." 2. Figured tapestry, Tasar silk.
3. Natural Tasar silk, woven fabric. 4. Natural Tasar silk, woven fabric.

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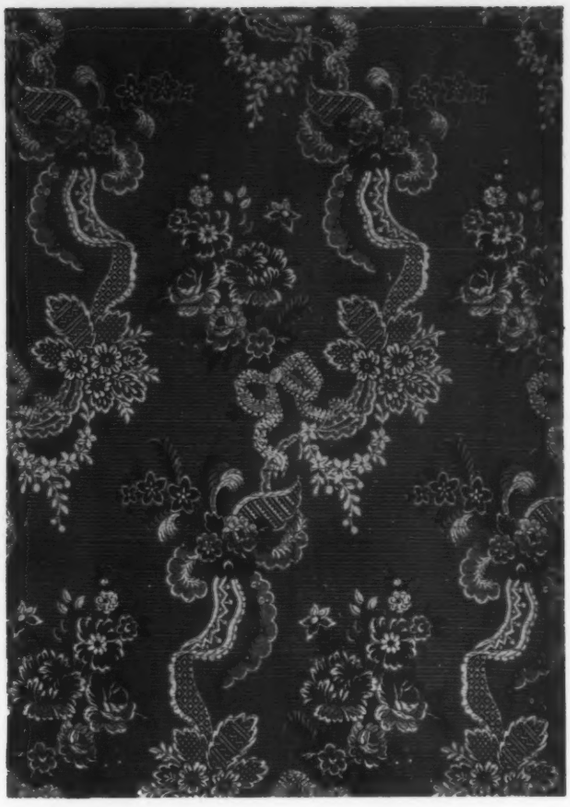

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8.—1. Silk Brocade, woven part Tasar silk. 2. Tapestry, the silk part of this fabric is Tasar Silk; the principal wild silk of India. 3. Tapestry, design worked in Tasar Silk; the woven part of which is Indian Tasar Silk. 4. Silk Brocade, the woven part Tasar Silk.

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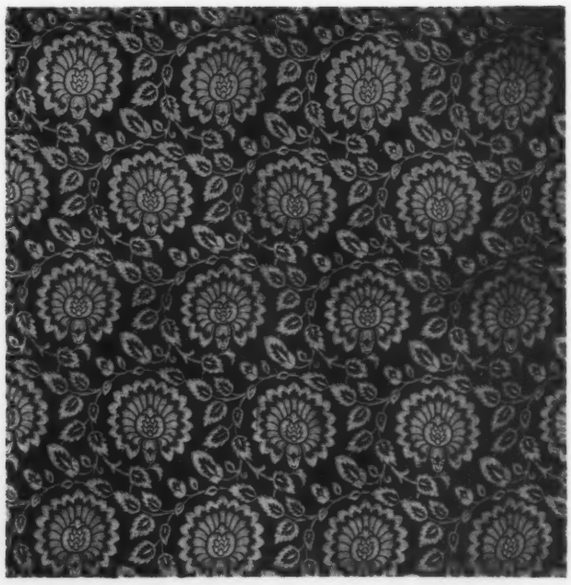


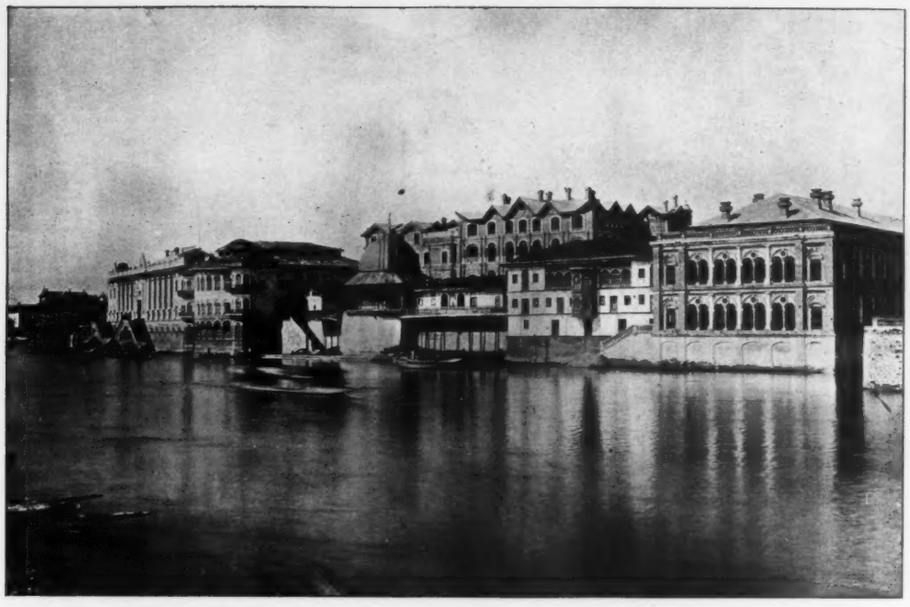
4

9.—Designs for silk fabrics, such as velveteens for example. 1. Pomegranate. 2. Damascus pattern. 3. Ambra design, (derived from the Mango ?). 4. Kharita design, (probably derived from a common ornament of brocade bags used for state letters.

Sir Thomas Wardle's House, St. Edward Street, Leek.
The smaller house is the Leek Embroidery School.

Swainsley.—The country home of Sir Thomas Wardle, on the Manifold River, Staffordshire.

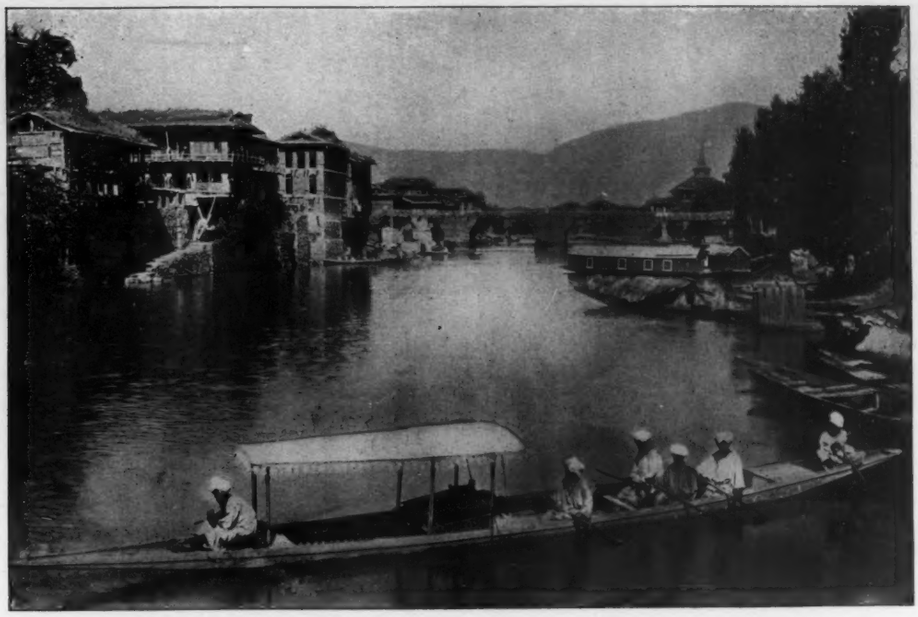
Plate 10.



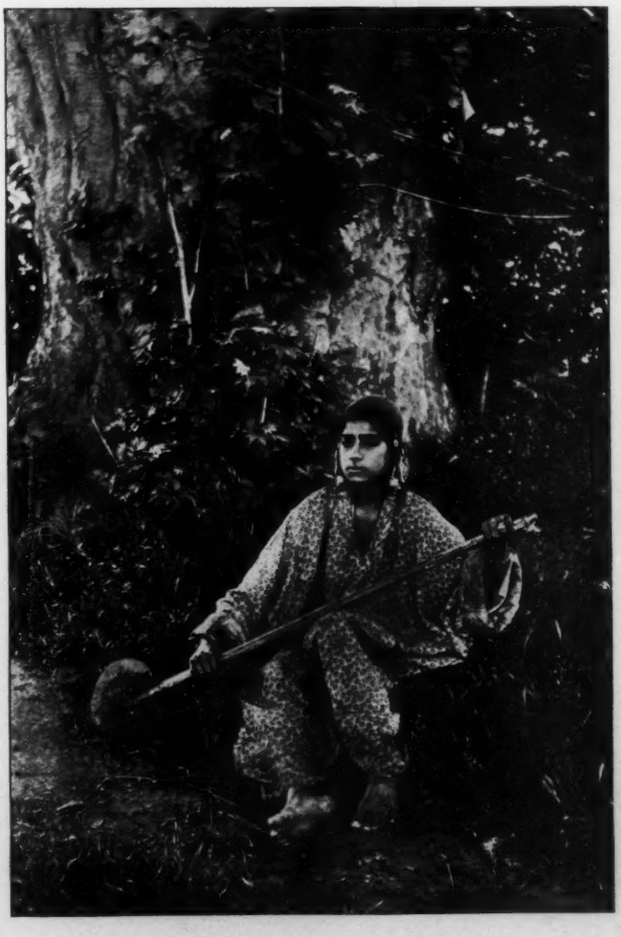
1. Palace of H.H. The Maharaja of Jamu and Kashmir on the Jhelum at Srinagar, Kashmir.

2. Major General H.H. Sir Pratap Singh, G.C.S.I., Maharaja of Jamu and Kashmir.

3. The late General, Raja, Sir Amar Singh, K.C.S.I., brother of H.H. The Maharaja of Jamu and Kashmir.

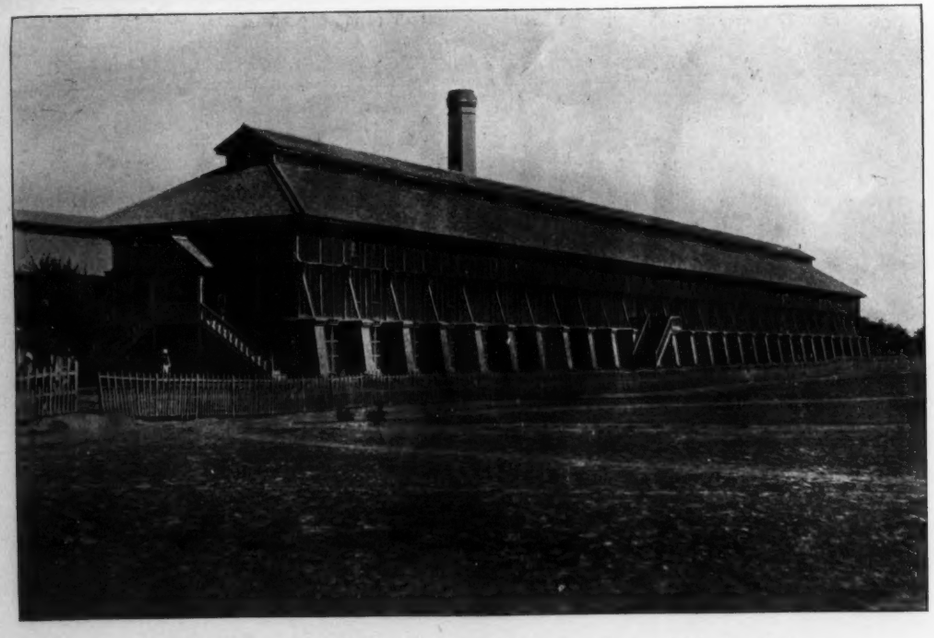


1. Third bridge and Srinagar city; showing the Mohamedan Mosque, Shah Hamadān in the distance.



2. A Jhelum steering boat girl with the customary heart-shaped oar.

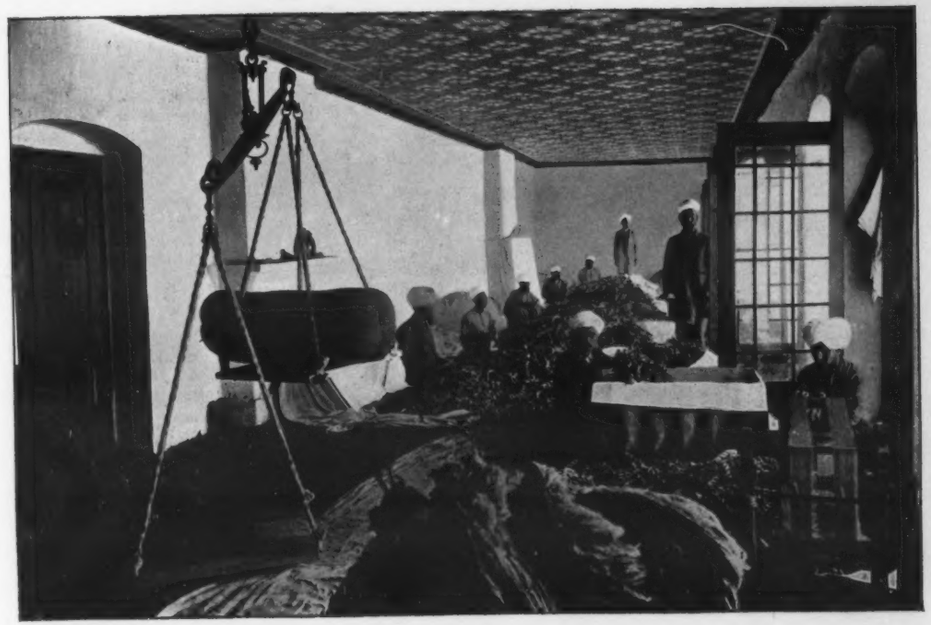
3. Hindu woman of Srinagar carrying water.



1. Srinagar Silk Filature. Length 435 feet, width 42 feet, containing 550 workers.

2. Interior of Filature in operation.

3. View showing the ends of Six of the Ten Cocoon-Reeling Filatures at Srinagar.



4. Baleing Room of the Srinagar Filatures.

1. Two Hibernation Houses for Silk-worm Eggs.

2. A group of Mulberry Trees near the Filatures at Srinagar.

3. Baramula, on the Jhelum, entrance into the valley of Kashmir, 30 miles from Srinagar.

4. View of the terraced agricultural operations between Srinagar and Islamabad.

The Journal of Indian Art and Industry.

INDIAN TIMBERS.

THE HILL FORESTS OF WESTERN INDIA.

By H. M. BIRDWOOD, C.S.I., LL.D., M.A.

IN reprinting, as an explanatory text of the fifty-nine coloured plates of Indian Timbers produced by me for the present and following issues of the *Journal of Indian Art and Industry*, the instructive and deeply interesting lecture on the "Hill Forests of Western India" delivered by the late Mr. Herbert Mills Birdwood, C.S.I., LL.D., M.A., at the "Greater Britain" Exhibition on the 4th July 1899, and published in the Journal of the Royal Society of Arts of the 4th August 1899, I preface it with this brief notice of his strenuous and beneficent life, not simply as a guarantee of the authority with which he dealt with the important subject of his lecture, but as an expression of my personal esteem and admiration for one who by virtue of his blameless and gracious life was one of the most exemplary ornaments of the Indian Civil Service.

Mr. Herbert Birdwood, who died in 1907, was born at Belgaum in the Presidency of Bombay in 1837. He received his early education at the New Grammar School, Plymouth, and Mount Radford School, Exeter, and from the first distinguished himself in the Natural Sciences and Mathematics. From Mount Radford School he was sent to the Edinburgh University, where he not only attended the lectures of Professor Pillans and Professor Blackie, but of Professor Forbes and Professor Kelland in Natural Philosophy and Mathematics respectively, and of Professor John Hutton Balfour on Botany; and so great was his proficiency in his mathematical and botanical studies that throughout their lives he was held in the highest regard and affection by Professors Kelland and Balfour. He also while attending these lectures formed a life-long friendship with the late Liberal Premier Sir Henry Campbell-Bannerman. After two or three years at Edinburgh he was sent to the University of Cambridge (Peterhouse), where he took his degree in 1858, coming out twenty-third in the Mathematical tripos and second in the Natural History tripos. In the same year, without the assistance of any "Crammer," he won his appointment in the open Competitive Examination—the first held—for the Indian Civil Service, coming out eleventh in the final examination. He was required for the Bengal Presidency, but his father, General Birdwood, being still in active service in Bombay, he was sent to that Presidency. There, after the usual career in the Revenue, the Judicial and the Political Departments, he rose at last to the highest official positions, viz., Commissioner for Scinde, Judge of the High Court, and Member of Council. Wherever he was stationed he prosecuted his botanical and other natural history studies, in which he was greatly helped by his marked facility in landscape painting, and his beautiful painting of flowers and birds; and he also everywhere laid out good gardens, always seeking to adorn them not with importations from Europe, which are costly exotics in India, that never become acclimatised, but with Indian flowering plants and trees obtained from the surrounding jungles. He also compiled a careful "Catalogue of the Flora of Matheran and Mahableshwar," and in the "Bombay Floras" of the Rev. Mr. Nairne and Dr. Theodore Cooke, C.I.E., he is named throughout their pages as the authority for the habitat of the rarer species of the wild plants of Bombay described by them. In four separate years Mr. Herbert Birdwood was Dean of the Arts Faculty, and in 1891-2 Vice-Chancellor, of the University of Bombay. He also edited several volumes of the Acts of the Legislature in force in the Bombay Presidency; and on retiring to this country in 1897, besides giving himself up to philanthropic and magisterial work, practising before the Privy Council, and collaborating with Mr. Justice Renton in the preparation of a revised edition of Burge's "British Colonial Law," he continued to devote himself with all the enthusiasm of his earliest years to the prosecution of his studies in natural history. It was indeed in this connection that he was seized with the attack of pneumonia, that with tragical suddenness terminated his earthly life on the 22nd February 1907. He was assisting at a lecture before the Indian Section of the Royal Society of Arts on a Thursday afternoon, and on the following Thursday he was laid in his secluded grave within the Twickenham Cemetery.

But the crown of Mr. Herbert Birdwood's life was the attractiveness of his high, earnest, and unaffected Christian character. He was known never once in all his life to have lost his temper. He never overlooked a wrong done to public interests, but he never punished the wrong-doer to his undoing, always knowing how to be gracious even to disgrace. These traits of a pure and noble character shone forth in his face, and whole demeanour and bearing, and were emphasised by all he said or did, light or grave; and it was this that at once attracted the confidence of everyone brought into personal contact with him, and, as the years passed, won their profound respects and warmest regard.

W. GRIGGS.

INDIAN TIMBERS.

By H. M. BIRDWOOD, C.S.I., LL.D., M.A.

It would be impossible, within the time prescribed for this paper, to attempt even a cursory description of the State forests in all parts of British India, or to render adequate justice to the work of the Indian Forest Department. I propose, therefore, to direct your special attention this evening to a limited area only in Western India, where the operations of the Department may be regarded as more or less typical of its general work. But, first, I should like to refer to some considerations which determine the applicability of a system of scientific forestry to any particular country, and to trace in outline the history of the measures adopted by the Government of India for the conservancy of forests in districts where scientific forestry is likely to secure permanent advantages to the people. I will also put before you some statistical information which may help to give an idea of the progress so far made.

It is obvious that in some parts of the globe it would be of no advantage at all to increase the existing forest areas, or to try to grow forests where no forests have ever yet grown. The increase of vegetation in some countries might indeed be a positive evil to the inhabitants. It might reduce the temperature of the air and of the soil where it is already cold enough for human comfort, as in places nearer to the Poles than we are ; or it might increase the rainfall in sea-bound regions which are damp enough already ; or it might unduly reduce the area of cultivation in thickly-populated countries where people are mainly dependent on their own lands and crops for sustenance. Or, again, the afforestation of new lands might not be required for the production of fuel, or of materials for building ships or houses, or for railways or machinery, in countries already well supplied with peat or coal or iron, or other substitutes for firewood and timber. And, lastly, employment on forest industries might not be a matter of public concern in places where other industries sufficiently occupy the time and intelligence of the people.

But India is not a country where such considerations prevail. Dr. Schlich, Professor of Forestry at the Royal Indian Engineering College at Cooper's Hill, in his admirable "Manual of Forestry," prepared ten years ago at the instance of the Secretary of State for India, primarily for the use of the Forest Branch of the College, tells us that, as a rule, the nearer we are to the equator the more important becomes the forest question. In a hot country, with distinct wet and dry seasons, forests may be necessary for the mitigation of extreme heat and dryness during a part of the year, and for the regulation of the flow of water in springs and rivers. The climate of a continental country may be improved by forests, and a mountainous region is, according to the same authority, more in need of forests than a low-lying country, because forests tend to prevent landslips and avalanches, and the washing away of soil from hill sides, and the consequent silting-up of rivers ; also they check the force and suddenness of destructive floods. In hilly countries, as elsewhere, forests provide protection from storms for men and beasts and birds.

Now India is distinctly a hot country, though in the northern provinces extreme cold is also felt in winter. It possesses, over a great part of its area, well-defined wet and dry seasons, dependent on constant causes recurring from year to year with the progress of the sun above and below the equator. Except on the sea coast it possesses a continental climate, or rather several types of continental climate, and though there are vast plains within its boundaries it is intersected by many mountain ranges, and even its plains and table-lands are broken by isolated hills and hilly tracts. It is clearly a land in which it would be suicidal to neglect the great question of forest conservancy. And yet it is only during the past fifty years that the vital importance of the question has been realised in British India. Early in the present century a timber agency was indeed established on the west coast, and in 1839-40 the Government of Bombay prohibited the cutting of teak trees on State lands. In 1843 Mr. Conolly, the collector of Malabar, made extensive plantations of teak at Nilambur, but no systematic plan for the maintenance of wooded lands for the supply of timber and other produce, or on account of their beneficial influence on the climate and public health, or for the protection of the soil or human dwellings from the violence of storms, and, in short, no plan for the regular administration of forests on well-ascertained principles was adopted till several years afterwards, when the danger of continued neglect could no longer be concealed.

There can be no question that at one time a very large part of the earth's surface was covered by forest growth, the destruction of which has affected the drainage of the soil and even its external configuration. Local climates have probably also been affected, though such causes as the drainage of marshes and the operations of husbandry are also believed to have contributed to such a result by altering the hygrometric, thermometric, electric, and chemical conditions of the atmosphere. As observed by Mr. George Marsh in his suggestive treatise on "The Earth as Modified by Human Action," "it is but recently that, even in the most populous parts of Europe, public attention has been half-awakened to the necessity of restoring the disturbed harmonies of nature, whose well-balanced influences are so propitious to all her organic offspring, and of repaying to our great mother the debt which the prodigality and the thriftlessness of former generations have imposed on their successors." As regards India the evidence disclosed by ancient writings seems to show that it was covered to a great extent at one time by forests. Dr. Schlich thinks that the country was more fertile then than it is now, and the climate less fierce ; and he refers to the testimony of the great

Chinese traveller, Fa-Hian, who described the climate as neither cold nor hot. Subsequently, as settlers began to occupy fertile valleys, forest lands along the banks of the great rivers were more and more cleared for cultivation. Such a proceeding was inevitable, and it would be idle to regard it as an interference with the order of nature, for, so long as it merely met the actual needs of human beings, it was really in aid of those harmonious methods by which, during countless centuries, the earth has been fitted for human habitation. But man must now take his part in the further development of those methods, if the great end in view is not to be defeated, and if successive generations of men are to pass on the inheritance they have enjoyed, not unimpaired merely, but improved to the best of their power. Such a conception of human duty was, however, unknown to the nomadic tribes, who, according to Dr. Schlich, for a period of more than 750 years carried on the work of destruction, not only in fertile valleys, but alike on hills and plains, as they moved from one pasture ground to another. In his preface to the catalogue of the Indian exhibit at the International Forestry Exhibition, held at Edinburgh in 1884, Sir George Birdwood says that it was the destruction of vegetation over wide extended areas at the time of the troubles following the decline of the Moghal Empire which thenceforward rendered India liable to desolating droughts and the consequent calamity of often recurring famines. "In the course of time," says Lieut.-Col. F. Bailey, formerly Superintendent of Forest Surveys and Acting Inspector-General of Forests in India, and now Lecturer on Forestry in the University of Edinburgh, "not only were large areas entirely cleared for cultivation and for village sites, but more numerous flocks and herds, driven for their daily food into the jungles, led to the impoverishment of a forest belt of ever-increasing width around the occupied tracts." During the hot season dry grass, fallen leaves, and dead wood were set on fire in order to clear the ground for a fresh growth of grass for cattle, and also to simplify the pursuit of game. But such practices, with those of overcutting and digging up roots for fuel, soon destroyed the protective forest growth, and heavy rains then washed away the soil. Cows and bullocks could no longer be kept in good condition on the scanty herbage that remained, and the villagers began to keep large flocks of goats, "against whose hoofs and teeth," as Lieut.-Colonel Bailey remarks, "it is well known that forest growth cannot contend." The village goats are still formidable foes to young plantations, though, in the estimation of Sir Clements Markham, "the uneducated man," in his dealings with forests, goes far beyond the goat in his capacity for mischief.

It would be satisfactory to be able to say that a wiser policy prevailed after the establishment of British rule. But, unhappily, that was not the case for many years. "With the advent of British rule," says Dr. Schlich, "the destruction of the forests became more fierce than ever." The extension of cultivation "at the cost of the still existing forests" was carried out for many years "without any inquiry as to the ultimate effects." With the introduction of railways a further impetus was given to cultivation in the immediate neighbourhood of railway lines and stations; and, with the steady increase of prosperity under a settled Government, the demands for timber and firewood increased enormously throughout the country, and thus the reduction of forest areas went on with all its attendant evils. In illustration of the evils which attend and follow the reckless destruction of forests, especially in hilly regions, Lieut.-Col. Bailey cites the case of the outer Himalayan spurs in the Hoshiarpur district of the Panjab, where, as the rock is very friable, serious damage has been caused by denudation. Within the memory of living men these hills were well covered with forests or tall grass, and the hill streams ran evenly in well-defined channels. But the natural vegetation has now almost entirely disappeared, the hills are crumbling away, and loose rocks and stones are carried down by the streams, which are often several hundreds of yards wide, and deposited in the plains below. "Thus, not only have the hills themselves become a dismal and profitless waste, but the fertility of extensive areas of cultivation near their base has been completely destroyed by the stony deposits laid on them."* Similar causes have produced similar effects in other parts of India. I can myself speak of some of the districts to the south of Bombay, between that great western ramp of the tableland of the Dekhan—the range of the Sahyádri Ghâts—and the sea, a narrow, hilly tract of land known as the Konkan, and traversed by numerous streams having their sources in the Ghâts. Within living memory many of the hills were well wooded, and some of the streams were navigable by larger craft than any that can now make their way to the towns and villages on their banks. Here, as elsewhere, disastrous results have followed the destruction of forests. The mould which, in the shelter of the jungle, had been formed during centuries on the rocky surface of the hills—to which it had been bound by a living network of fibrous roots—became exposed to the full force of the monsoon rains. The average annual rainfall near the sea amounts to about 80 inches, and gradually increases till, about 30 miles inland, at the ridge of the Ghâts, which forms the watershed of the rivers flowing eastwards and westwards, it reaches an average of about 280 inches in the year. A wide view of these Konkan hills is obtained from the hill station of Mahableshwar, on the crest of the Western Ghâts, at a distance of about 80 miles in a south-easterly direction from Bombay, and I well remember a conversation I once had there with Mr. Allen Shuttleworth, who for many years held with distinction the office of Conservator of Forests, from which he has lately retired. Like other officers of his Department he was full of zeal for his work, and spoke in indignant terms of the folly and the mischief of which the evidence lay before us

* Lieut.-Col. Bailey on "Forestry in India," *The Scottish Geographical Magazine* for 1897, p. 576.

in sun-baked summits and barren sides of hills which, not very long ago, were clothed with all the glory of tropical vegetation. It is not easy to appreciate all the mischief that has been done. The silting up of waterways alone means commercial loss to the whole country side. It also means agricultural and pastoral loss to those from whose possession the soil itself has slid away, past recovery. In many places in the Southern Konkan district good soil is only now found in depressions on the surface of the laterite rock of the district, from which it could not be washed away. The whole community must suffer also from the increased cost of fuel and timber.

It is easy, in the light of our present knowledge, to condemn the heedless policy of the past, but I doubt whether it is for us in England to cast the stone. Though England has done a great deal towards the education of scientific foresters, we have the testimony of Sir Joseph Fayrer that it makes one almost ashamed, when travelling almost anywhere on the Continent, to see how comparatively well the woods are cared for there, and how they are neglected here. "There were miles and miles," he is reported to have said, "especially in the north, where there were only little bits of cover here and there, thoroughly neglected and of no use at all except, perhaps, as shelter. There was no knowledge and no care, trees were planted and left to grow or be blown down by storms, and there was practically no re-planting."* Such a remark would not, I think, be applicable to any rural district of British India at the present day.

It was not, however, until the increasing difficulty of meeting demands for public works indicated unmistakeably the existence of a timber famine, that the Indian Government realised the gravity of the situation. According to Dr. Schlich the remedial measures at first adopted were only "half-hearted." But when their insufficiency was made clear a special State Department was organised. The efforts which preceded that event were not, however, unimportant or without effect on subsequent arrangements. Indian botanists had long urged on the Government the necessity for establishing a regular system of forest administration and preventing, in the public interests, the continued destruction of public property of enormous value ; and the dawning of a new era was marked by the appointment, in 1847, of the late Dr. Gibson to be Conservator of Forests in the Bombay Presidency. The most important duty assigned to him was the maintenance of the supply of teak for ship-building to the Government dockyard in Bombay, and his work as a pioneer of practical forestry was of special value in Western India, where he was familiarly known as "Daddy Gibson," and is still remembered with affection by the people of the Junar district above the Ghâts, where he had his head-quarters. As early as in 1847 the well-known name of the late Dr. Hugh Cleghorn, who has been described as the father of scientific forestry in India, appears in a report on the proposed conservation of forests in Mysore. In the following year our Chairman, General Michael, who was then Lieut. Michael of the 39th Madras Infantry, and has been described by Sir Joseph Fayrer as the father and pioneer of practical forestry in India, was entrusted by the Government of Madras with the organisation of an establishment for working and conserving the public forests near Coimbatore and Cochin. He opened out forest roads and timber slips down the mountain passes and cleared belts of brushwood to preserve young saplings from fire. Indeed, in the Anamalai teak forests he made "the first recorded attempt to protect Indian forests from injury by annual jungle fires."† Also by giving employment to the hill tribes he secured their co-operation in his plans. In the discussion on a paper on Forestry, read by General Michael before the Society of Arts in December 1894, Sir George Birdwood referred to certain attempts in the same direction made about the same time in Bombay and Tennaserim, which, however, met with no success, partly because they were on too ambitious a scale, and partly because the ancient forest rights of the people were not sufficiently considered. "General Michael," he said, "set to work in a more modest manner and in a far more conciliatory spirit, and after six years his exertions, which completely broke down his health, were crowned with such success that the Court of Directors in London at once took up the subject warmly, and rapidly extended the Madras system of conservancy all over India and as much of Farther India as was under their rule." I trust our Chairman will forgive my quoting these words in his presence. I have felt myself bound to quote them in justice to my subject and in deference to you who look to me for a full statement of facts. In the same discussion General Michael was referred to by Sir Joseph Fayrer as "certainly one of the great benefactors of India."

No account of Indian forestry, however summary, would be satisfactory without a reference to his services. It was the enthusiasm born of a love of woodland life, innate in such men as Dr. Gibson and himself, and the out-of-door experience acquired by them and others, whether as foresters or sportsmen, and interested as such in every phase of forest craft, which really prepared a firm foundation for the stately fabric of scientific forestry raised by their successors.

(*To be continued.*)

* *Journal of the Society of Arts*, vol. xliii., p. 107.

† Lieut.-Col. Bayley on "Forestry in India," *The Scottish Geographical Magazine* for 1897, p. 576.

It was from the city of Edinburgh, with its grand botanic gardens and its long array of men of science—prominent among them, in our own time, in connection with much that relates to the science of forestry, being Professors James Hutton Balfour and Bayley Balfour—that the effective impulse was received which determined the further development of the Forest Department. In 1850 the British Association met in Edinburgh and appointed a Committee to consider the probable effects, from an economic and physical point of view, of the destruction of tropical forests. In the following year the Committee presented at Ipswich a report which embodied the general conclusions and recommendations arrived at, and demonstrated clearly the importance of preserving every condition tending to maintain an equilibrium of temperature and humidity, of preventing the disappearance of indigenous forests from the wasteful habits of the people, and of taking the requisite steps for extending forest produce. The weighty evidence adduced by the Committee, and the broad views enunciated by them, so impressed the Court of Directors that, within a few years, regular establishments were sanctioned for the Madras Presidency and British Burmah. In 1856 Dr. Cleghorn took up General Michael's work, and was appointed Conservator of Forests in Madras, with Captain Douglas Hamilton and Lieutenant Beddome as his assistants, who in turn succeeded him in the office of Conservator after his transfer, first to Bengal, where he gave most efficient aid to Dr. Brandis in carrying out forest conservancy, and afterwards to the Panjab. According to Colonel Bailey, Dr. Cleghorn checked the destructive practice of temporary cultivation in the Madras forests notwithstanding the opposition he encountered. He was ultimately successful "because his well-known desire to promote native interests inspired the rulers of the country with confidence in his proposals." In 1856 also, Dr. Brandis (now Sir Dietrich Brandis, K.C.I.E.) was appointed Superintendent of Forests in Pegu, and six years afterwards was placed on special duty with the Government of India. He was the first Inspector-General of Forests to the Government of India, and held the office till 1881, when he went on special duty to Madras. His book on the Forest Flora of North-Western and Central India is a standard work, greatly prized by Indian botanists and foresters. "From the time of his appointment," says Sir George Birdwood, in his preface to the catalogue of the Indian exhibit at the International Forestry Exhibition, already referred to, "the successful future of forest conservancy in India was assured. . . . . He, in fact, by his great capacity, his wise recommendations, and his personal example of enthusiastic devotion to duty, has made the Forest Department of India what it now is." We owe to Dr. Brandis, among other important services, the suggestions for the various Indian Forest Acts, which, while strengthening the hands of the Government, have secured to the people the maintenance of all the ancient rights and privileges inherited by them from time immemorial; and also the inauguration, in 1866, of arrangements for the annual supply of trained officers to discharge the duties of assistant conservators of forests in India. At first these officers were educated in France and Germany. In 1876 the student candidates were withdrawn from Germany and stationed at Nancy under an English officer. In 1885 Dr. Schlich (who had succeeded Dr. Brandis on his retirement) organised the Forest Branch of the Royal Indian Engineering College on its present footing at Cooper's Hill.

While candidates with special qualifications for the higher grades of the Forest Department are, with some exceptions, now recruited from England, it is obvious that there must be much important work connected with the executive charge of the forest ranges, into which the larger divisions are split up, the disposal of which the Government of India must entrust to officers trained in India itself. The class of Forest Rangers has been described as the "backbone" of the Department. Candidates for this branch of the forest service are trained at the Imperial Forest School at Dehra Dun, which is attended by students from all parts of India. A certain number of forest appointments has also been guaranteed annually by the Government to the students of the College of Science at Poona. A protective service of Forest Guards is also employed for the purpose of patrolling forests and ensuring compliance with forest regulations. The members of this branch of the service receive no professional training.

The Indian Forest Service thus organised has been able not only to meet the demands of India, but to help other countries also. Ceylon, New South Wales, New Zealand, the Cape, Mauritius, Jamaica, and Cyprus, as General Michael, in his paper on Forestry tells us with just pride, have all borrowed officers from India to put them in the way of organising conservancy and working their forests economically. The head of the Forest Department at the Cape and the Conservator in Ceylon are both Indian forest officers. The United States of America have also recognised the value of the work done in India by lately deputing an expert to study the methods there in force.

The forests to which the Indian Forest Act of 1878 is applicable include "reserved forests," which are State property, or over which the State has certain rights; "village forests," assigned or yet to be assigned by the Government to village communities from reserved forest areas; "protected forests," which, as regards the proprietary rights of the State, are on the same footing as reserved forests, but are subject to less stringent supervision—only certain kinds of timber being protected, and all private rights of cultivation, pasturage, and wood-cutting within the protected area being respected; and, lastly, "private forests," which are controlled only to such an extent as is necessary for their regulation or protection for certain special purposes. The Forest Department has also the control of State plantations of timber trees.

The area of British India, exclusive of the Native States, is about 960,000 square miles; and of this area more than 79,000 square miles had been constituted as reserved forests before the end of the year 1896-7. About 9,000 square miles were "protected," and nearly 26,000 square miles were tabulated as "unclassed." The total area under the control of the Forest Department amounted, therefore, to about 114,000 square miles, inclusive of about 1,100 square miles leased from Native States. Of this area, which is only about 7,000 square miles less than that of the British Isles, about 32,000 square miles are closed to all animals, and about 41,000 to browsing animals only. I am unable to give any exact statistics as to village forests and private forests, but it has been estimated that the area of private forests and forests belonging to corporations and endowments is about equal to that of the State forests, and that the total area of forests of all kinds is about 25 per cent. of the total area of British India. In Great Britain and Ireland the corresponding percentage is only 4. The corresponding figures for Europe and the United States of North America are 31 and 17 respectively. In European countries the highest percentage is reached in Servia, where it is 48; in Russia and Sweden it is 42; in Austria, 33; in Hungary, 29; in Germany, 26; in Norway, 25; and in Turkey (including Bulgaria, Bosnia, and Herzegovina), and also in Roumania and Italy, 22. In Switzerland, Spain, France, Greece, and Belgium, it lies between 19 and 15. In Holland it falls to 7, in Denmark to 6, and in Portugal to 5. Great Britain and Ireland thus show the lowest percentage of all the countries named, while India comes seventh in the list, being bracketed with Norway.*

The area of plantations directly under the Government of India and the Government of Madras is said to extend to 41,000 acres. In the Bombay Presidency the afforestation of waste tracts has been pushed with vigour, but I am unable to give the acreage. One of the plans adopted by Mr. Shuttleworth in the central division—as he has personally explained to me on the site of some of his operations on the hills near Poona—has been to sow the seeds of all kinds of forest trees and shrubs broadcast on the ground. The results of the annual sowings have been satisfactory, except in seasons when the rainfall has failed at the close of the monsoon. Hill tops and stony valleys, which, twenty years ago, were bare and unsightly, are now well covered with innumerable saplings and most refreshing verdure. Similar results have been obtained on many of the rocky hills of the Dekhan.

The review of Forest Administration in British India for the year 1896-7, by Mr. B. Ribbentrop, C.I.E., Inspector-General of Forests, shows that in that year, which is the latest for which I have any report, the State forests yielded more than 47,000,000 cubic feet of timber, nearly 100,000,000 cubic feet of firewood, nearly 135,000,000 bamboos, and minor produce to the value of nearly 3,250,000 rupees.

In the same year the exports from British India to foreign ports included 64,221 tons of teak wood, valued at nearly 7,000,000 rupees; sandalwood, ebony, and other ornamental woods, worth nearly 600,000 rupees, and such minor produce as caoutchouc, lac, lac-dye, cutch and gambier, myrobalams and cardamoms, worth about 21,000,000 rupees.

The total value of exports, which reached nearly 28,500,000 rupees, was less by 6,500,000 rupees than the total value for the preceding year, the decrease being due almost entirely to the disastrous effects of plague and famine.

The gross revenue realised from forests during the year 1896-7 amounted to nearly 18,000,000 rupees, the surplus over expenditure having been 8,000,000 rupees. More than 17 per cent. of the gross revenue represented the estimated value of forest produce given away free or at reduced rates to right-holders and free grantees. When it is remembered that before 1848 the forest revenue, which was treated as a branch of the land revenue, was very trifling, the progress made in the past fifty years is very remarkable. But, as most truly observed by Sir George Birdwood, in the paper from which I have already quoted, "the annual revenue which forest conservancy has as yet provided is utterly insignificant when compared with the capital value of the Indian forests redeemed by the British Government from certain destruction."

It would indeed be strange if such results had been achieved without opposition. I have already spoken of the conciliatory course adopted with obvious advantage by some forest administrators towards those whose privileges were affected by the stringency of the new regulations. Villagers on the outskirts of forests had for generations cut firewood and grazed cattle therein, and cleared patches for cultivation without hindrance. The policy aimed at has been to stop the exercise of privileges incompatible with the continued existence of forests, and to allow others as far as possible. But the necessity for a restrictive policy at all, while necessarily distasteful to right-holders, was not readily accepted as right by the local officers of the Indian Civil Administration, with whom it has always been an honourable tradition to seek above all things the happiness and contentment of the people. They were unable to look with favour on measures which seemed to indicate an excess of zeal on behalf of the State, and to be in needless derogation of privileges long enjoyed without much apparent injury to public interests. It has been suggested that though the accumulated mischief, caused by neglect of conservancy during a long series of years, is incalculable, yet it is not possible always to detect any

* Schlich's "Manual of Forestry," vol. i., p. 54.

appreciable damage done in a particular locality during a short period. Such a consideration alone might partly explain the tendency to reject as idle the fears of experts, and to resent measures savouring of harshness and productive of discontent. In course of time, as forest management became stiffened and matured, friction was undoubtedly developed, and gave rise to difficulties. One of the purposes of the Forest Act of 1890 was to give effect to recommendations for reconciling legitimate local demands with State requirements which were made by the Bombay Government on a consideration of the Report of a Forest Commission appointed with the object, as publicly declared by Lord Reay, of substituting "co-operation for antagonism, confidence for distrust, contentment for disturbance." The Bombay Government has recognised the principle that the central authority in forest matters, so far as the interests of the people are concerned, shall be the Commissioner of the Civil Administrative Division, and that the Forest Department cannot be regarded as the rival of the Revenue Department in respect of such matters. You will not expect me to give any details in illustration of the practical working of this principle. The result has been to bring the Forest Administration into closer union with the general Civil Administration of the country, to remove many causes of complaint, and to place forest work altogether on a sounder footing.

The particular area of which I spoke at the beginning of this paper is within easy reach of the City of Bombay. It includes hilly tracts of country on either side of the range of the Western Ghâts, in the Dekhan and Konkan respectively, between the latitudes, roughly speaking, of Bombay and Satara. As compared with other forest areas elsewhere in the Presidency, it is by no means remarkable, so far as the production of valuable timber is concerned; but it is of interest as illustrating generally the methods of the Forest Department; and it is of special interest to the inhabitants of Bombay and many other cities in the plains, as it includes the two popular hill stations of Matheran and Mahableshwar, which owe much of their value as health resorts to their pleasant woods and abounding undergrowth of beautiful shrubs and flowering plants and ferns, which everywhere keep the ground cool and the air sweet and fresh. Both in climate and splendour of wild woodland scenery they furnish an instructive contrast with those hills of the same tract which have suffered from the destruction of forests in the manner I have already described. An account of the forest flora of Matheran and Mahableshwar will apply generally to similarly preserved portions of the Western Ghâts and the adjoining regions; and, in the time that is left us, it will be sufficient, perhaps, if I deal only with the flora of these two hills. Their vegetation is not indeed identical. Dr. Theodore Cooke, formerly principal of the College of Science at Poona and an accomplished botanist, who always found his "pleasure in the pathless woods" whenever he could escape from college lectures, has estimated that, exclusive of grasses, about 140 flowering plants are found at Matheran which have not been seen at Mahableshwar, and 130 at Mahableshwar which have not been seen at Matheran. Some of the conditions which regulate the distribution of plants are not indeed equally operative at both places. Mahableshwar is about seventy miles nearer the equator than Matheran. The latter is an isolated hill rising from the plain of the Konkan, midway between the Ghâts and the sea; whereas Mahableshwar is further from the sea, and is, to all intents, a part of the range of Ghâts. The highest point of Matheran is about 2,500 feet above the sea-level, whereas the Mahableshwar plateau is at a general elevation of 4,500 feet above the sea, and rises at one point to 4,700 feet. These differing conditions are not without their effect. Some plants are found at Mahableshwar which will not thrive on the lower mountain top. Some Matheran plants, on the other hand, find the higher levels of Mahableshwar beyond their range. I will give a few instances. The most casual observer is struck by the wonderful undergrowth of brake-fern at Mahableshwar, and of the arrow-root plant—which in October and November blooms on almost every square yard of the jungle—and by the beautiful profusion of the *Osmunda* fern, mixed with clustering roses and willows, along the upper stream of the Yenna river. At Matheran the brake-fern is scarcely known. In a few years it will be extinct, if it is not already so; for being rare it has been the prey of thoughtless fern-hunters and cannot defy their onslaughts. It would be impossible for any number of fern-hunters to destroy it at Mahableshwar, and so it is left alone. Even if unmolested at Matheran it drags on at best but a feeble existence. The site is too low for it, the lowest limit of its range in the latitude of Bombay being apparently a little more than 2,000 feet above the sea-level. The Osmunda, again, is not known at Matheran, nor is the Willow (*Salix tetrasperma*), nor the Arrow-root (*Hitchenia caulina*), though other allied plants of the order *Scitamineæ* are plentiful enough. On the other hand, there are some well-known Matheran trees, such as the Kumbha (*Careya arborea*), the Malia or Indian ebony (*Diospyros assimilis*), and the Chandára (*Macaranga Roxburghii*), which do not grow on the Mahableshwar plateau at all. But after full account is taken of all divergences, it is found that many plants are common to the two hills. Such a coincidence is favoured by the practical identity of their geological formation, and by the circumstance that there is no great difference in the range of their mean temperature at different seasons and in their rainfall. Both Mahableshwar and Matheran are huge masses of trap, capped by a thin layer of laterite. Both are within sight of the sea. Both are swept by the same dry winds in the cold weather, and by the same monsoon storms, and both enjoy the full benefit of the monsoon rains. The average mean temperature ranges at Mahableshwar from 63·3° Fahr. to 71·7°, and from 67·8° to 73·5° at Matheran. The average annual rainfall at Mahableshwar amounts to 281·4 inches, and at Matheran to 224·7 inches. Under such

concordant influences it is not surprising that a marked similarity should be apparent in the general outward forms of vegetation on the two hills, due to the frequent presence of the same characteristic plants on both. Everywhere at Mahableshwar, as at Matheran, we find the Myrtle tribe represented by endless woods of the beautiful Jambul tree (*Eugenia Jambulana*), the Melastomas by the Anjan or Ironwood (*Memecylon edule*), the Laurels by the Pisa (*Litsæa Stocksii*), and the Madder tribe by the thorny Gela (*Randia dumetorum*)—a small tree, generally a shrub, with numerous stiff branches, armed with spines, and large fragrant white flowers, which turn yellow before they fade. There is the same undergrowth of shrubs and herbaceous plants, the natural orders of *Leguminosæ*, *Acanthaceæ*, and *Compositæ* being specially and numerously represented. There are many showy climbers, trailers, and creepers, and Orchids and Dendrobiums common to both hills, while everywhere the little silver fern covers with equal impartiality every sheltered bank and rock. Some years ago, before leaving India, I prepared for the "Bombay Natural History Society's Journal," with the aid of several competent botanists, a catalogue of the flora of Matheran and Mahableshwar. I cannot pretend that it is a complete list, for the simple reason that during the four rainy months of the year, when most herbaceous plants are at their best, the hills are practically inaccessible to Europeans; but in addition to the hill flora it includes some of the more conspicuous plants on the higher levels of the road from Poona to Mahableshwar; and the list of forest trees, which are conspicuous at all times, may perhaps be accepted as complete. It may interest you to know that of the 733 names included in the catalogue, about 125 are the names of trees or sub-trees, as distinguished from shrubs, creepers, grasses, ferns, and undergrowth generally. Of the trees probably not more than ten species have been introduced, and about 115 species are probably indigenous. They constitute but a small proportion of the indigenous trees found throughout India, the number of which exceeds 2,000 species, but they give some idea of the diversity of forest vegetation in the limited area under consideration, if we bear in mind that the number of species of indigenous trees in Great Britain is only forty.*

The trees which have been distinctly introduced are the Peach, which is cultivated at the hill station of Panchgani, near Mahableshwar; the Stringy Bark (*Eucalyptus obliqua*), which does not take kindly to Mahableshwar, the rainfall there being evidently too heavy for it, but does better at Panchgani—which, at a distance of only ten miles from Mahableshwar, has a much lower rainfall—though not nearly so well as on the Nilgiri Hills; the *Cinchona succirubra*, which again has not been a success, as on the Nilgiri Hills and elsewhere; the Cassowary tree or Beefwood (*Casuarina equisetifolia*), which has been extensively planted at Panchgani, but much prefers the lower lands nearer the sea, and especially the sandy beaches of the Konkan coast; the Oak (*Quercus robur*), of which, however, there are very few well-grown trees; and the Mulberry (*Morus alba*), which was probably brought from China.

Among the more important or more conspicuous trees which may be regarded as indigenous are two species of Garcinia—the wild Mangosteen (*Garcinia indica*) and the Gamboje tree (*Garcinia ovalifolia*), and two species of Sterculia—the *Sterculia urens*, from the wood of which native guitars are made, and the Goldar (*Sterculia guttata*), conspicuous by its large, peach-shaped fruit, covered with scarlet down; the Silk-cotton tree (*Bombax malabaricum*), which attains a great size, and is a tree of strange beauty when in full bloom, with its large, showy, rose-red flowers; the Kâsu (*Elæocarpus oblongus*), with leaves turning red in autumn, and clusters of flowers with white-fringed petals and reddish-brown sepals; the Frankincense tree (*Boswellia serrata*), which is plentiful on the Ghât road between Poona and Mahableshwar; and another balsamiferous tree, the *Canarium strictum*, yielding a gum, burnt as incense by the hill people at their religious services, and much sought after on account of the rarity of the tree, of which I have found only one specimen at Matheran, to my lasting wonder at its presence there, in a thick wood, far from its congeners, and hemmed in by countless aliens; the *Garuga pinnata* (belonging also to the same natural order *Burseracæ*), the bark of which is used in tanning; the Indian Satin-wood (*Chloroxylon Swietenii*), an excellent wood for cabinet work of the better kind; the Indian Red-wood or Bastard Cedar (*Soymida febrifuga*), the bitter bark of which is used as a substitute for cinchona bark; two species of the Jujube tree (*Zizyphus*); the Koshimb tree (*Schleichera trijuga*), on the young branches of which lac is produced in many parts of India; the well-known Mango tree (*Mangifera indica*), which is found wild on many hills, though sometimes said to have been introduced by the Portuguese monks from Brazil; the "Flame of the Forest" (*Butea frondosa*), which has given its name—"Palas" in the vernacular—to the memorable plain of Palâsi, commonly known as Plassey; the Blackwood tree (*Dalbergia latifolia*), of which is made the elaborately-carved furniture, which at one time was much prized in Bombay; the beautiful Indian laburnum (*Cassia fistula*); the *Acacia Suma*, from the wood of which Catechu is manufactured; and yet another beautiful representative of the order *Leguminosæ*, the Laeli (*Albizzia stipulata*), a very conspicuous tree at Matheran, with clean stem and spreading branches, finely pinnate leaves, and large acacia-like flowers, with numerous white, lilac-tipped stamens; the Ain (*Terminalia tomentosa*), a valuable timber tree; the Myrobolam tree (*Terminalia Chebula*), which is found in great abundance on Mahableshwar, the fruit—the Chebulic Myrobolam of commerce—being largely exported, coming indeed, for the whole

* Lieut.-Col. Bailey on "Forestry in India," *The Scottish Geographical Magazine* for 1897, p. 572.

of India, third on the list of exports of forest produce as regards valuation, and second as regards quantity; the Jambul tree (*Eugenia Jambolona*), already referred to, which may be regarded as the most characteristic tree of both Matheran and Mahableshwar, impressing, as it does most effectually, its grace of form and beauty of colour on all the landscape and shading the ground everywhere with a cool canopy of sweet-scented leaves; another tree, also of the Myrtle order (*Careya arborea*), which has been already referred to; the Ironwood (*Memecylon edule*), which has also been referred to and is also a characteristic tree of both hills, with its dark shining leaves like the leaves of the Camellia; the Benteak tree (*Lagerstroemia parviflora*), which yields a wood of excellent grain for the cabinet-maker; the Kánta Kumbal (*Sideroxylon tomentosum*), a tough, hard-grained tree, as its name implies; the *Bassia latifolia* or Mowrah tree, from which Mowrah liquor is made in other parts of India; and yet a third tree of the Sapodilla order, the Bokul (*Mimusops Elengi*), with dark green foliage and honey-scented flowers; the *Diospyros assimilis*, one of the Indian ebonies; the Kaola (*Symplocos Beddomei*), with blossoms scented like the hawthorn and blue berries; the wild Olive (*Olea dioica*); the Wáras (*Heterophragma Roxburghii*), a tall tree of the Bignonia or Trumpet-Flower Order, with grey pinnate leaves and clusters of showy white bell-shaped flowers; the Teak tree (*Tectona grandis*), the most important of all the forest trees; the Shewan (*Gmelina arborea*), the pale yellow close-grained wood of which is used for planking, furniture, the panels of doors, etc.; the wild Nutmeg (*Myristica attenuata*); and fifteen species of the Laurel order, all notable and some of them very beautiful trees, the two most notable being the *Litsæa Stocksii* already referred to, a shapely laurel rising to a height of twenty feet or more, and generally assuming a pyramidal tapering form, and displaying whorls of pale bluish leaves—a very characteristic tree of both hills—and a species of Cinnamon (*Cinnamonum Tamala*), of which I have found only four specimens, all at Matheran—a striking and handsome tree, though of no great size, with tufts, when first bursting into leaf, of small pink transparent leaves, which afterwards lengthen and become pointed at both ends, and have marked ribs or nerves, and are dark and shining above, and when dried turn to a rich brown and yield a spicy scent when crushed. These, with several species of trees of the Spurgewort order (*Euphorbiaceæ*), which is well represented on both hills, and includes the *Macaranga Roxburghii* already referred to, and readily recognised by its large ovate and peltate leaves, and the Hasána (*Bridelia retusa*), a good timber tree; and of the genus Ficus, which includes the well-known Banyan tree, the sacred Pipal, the Sycamore tree of the Bible, and other Figs not so well known; the stately and fine-foliaged Jack tree (*Artocarpus integrifolia*), with its enormous fruit, allied to the Figs; the Willow (*Salix tetrasperma*), and the Fish tail palm (*Caryota urens*)—the only palm included in my catalogue—make up a fairly full list of the more conspicuous of the forest trees on the two hills.

I wish I could convey to you something more than a dim conception of the beauty and perennial charm of these Indian woods. But that is beyond my power. It will be enough for me, and I shall be quite satisfied, if, by my narrative, imperfect and meagre though it be, I shall have helped you in any degree to appreciate the value of the great work done by those who have preserved and improved the forest tracts of British India to the lasting benefit of the State and the people.

H. M. B.

In proposing a vote of thanks to the lecturer for his highly interesting and instructive paper, the Chairman (General Michael) said that, as Mr. Birdwood had paid him the compliment of alluding to him personally in connection with the early efforts of the Madras Government to introduce a workable system of forest conservancy into India, he might perhaps add a few words to what Mr. Birdwood had said. There are few men, he said, now left alive among the Indian services who knew or could remember—as he did—what the state of affairs was, as regards forests, half a century ago, when the Madras Government made the effort spoken of. In those days hundreds of acres of primeval forests used to be ruthlessly cut down and burned by the inhabitants for the sake of a few scanty crops of millet. Timber merchants used to be allowed to go into richly-wooded tracts and work their wicked will. No thought seemed to be taken of the hereafter, but in 1848 an experimental establishment was organised for the protection and the economical working of one of the most valuable tracts of forest in the far south of the Madras Presidency. Mr. Birdwood had stated that, after seven years of somewhat uphill work a pronounced success, both financial and preservative, was achieved, and the ball was thus set rolling. Success was the one thing needed to cause the Court of Directors of the East India Company to take the matter up warmly—conservancy measures and establishments spread rapidly all through India—and with what result? In 1848 the forests of India were fast being ruined by neglect and reckless waste, and the revenue was practically *nil*. By 1898 all existing forests were not only saved and put under good care, but he (the Chairman) was afraid to say how many thousands of acres or square miles had been planted or reafforested, and the net annual revenue stood at £1,000,000 sterling or more. By that time also most of our colonies and dependencies, and

even the United States, had taken a leaf out of India's book, and had established forest conservancy departments. Of course, this gigantic success is due to the measure having reached Imperial proportions. Madras can only take credit for a share of it, but she is justly entitled to look back with satisfaction to her pioneering scheme having been started on a sound basis, and to its having thus proved a success. Too much stress cannot be laid on the value of two principles on which the work was begun—firstly, that full and liberal recognition and respect for the ancient communal rights of the people should always be maintained; and secondly, that, in carrying out forest conservancy, preservation of the natural resources should be the first consideration, and the acquisition of revenue a secondary one. The ancient rights of the people over forest land is a matter with which it is vitally necessary to deal in a liberal spirit. The early records of the India Office show that on this rock both Bombay and Tenasserim split when conservancy was first attempted there. This same rock has frequently cropped up since, as all forest officers know well—and a most dangerous one it is, because if once the local people think they have been badly or illiberally treated they have a thousand and one methods of showing hostility to the Department, and, maybe, to the Government itself. It was highly satisfactory to see that Lord Roberts, in the political part of his autobiography, took a clear-sighted view of this very question, and sounded a note of warning against undue over-riding of ancient forest rights, as a probable fertile source of discontent in India. He thanked Mr. Birdwood warmly on behalf of the meeting.

DESCRIPTIONS OF PLATES 21, 28 and 33.

21.—*Eugenia jambolana.* Black Plum, Jaman. Evergreen. Wood reddish-grey, moderately hard, darker near centre. Weight 48 lbs. per cubic foot. Used for native building purposes, agricultural implements, rice-mortars, carts, and for well work, as it resists action of water. Gives a good fuel. One of the trees on which the tásar silkworm is fed. GAMBLE.

28.—*Diospyros Kurzii.* Andamanese Marble Wood. Evergreen. Wood hard, but liable to shrink and warp, useful for cabinet work, sticks, frames and carriages. Should be of great value in European market, if known and supplied. GAMBLE.

33.—*Dipterocarpus Hasseltii.* (Andaman Gurjan) (=D. turbinatus.) The Gurjan Oil-tree. A lofty evergreen, 150 to 200 ft. high. Sapwood white, heartwood red-brown. Its wood-oil is largely collected and exported, and is also used for painting houses and ships. The timber is used for house-building, canoes and packing-cases, but is soon destroyed by white ants and therefore not much in estimation. GAMBLE.

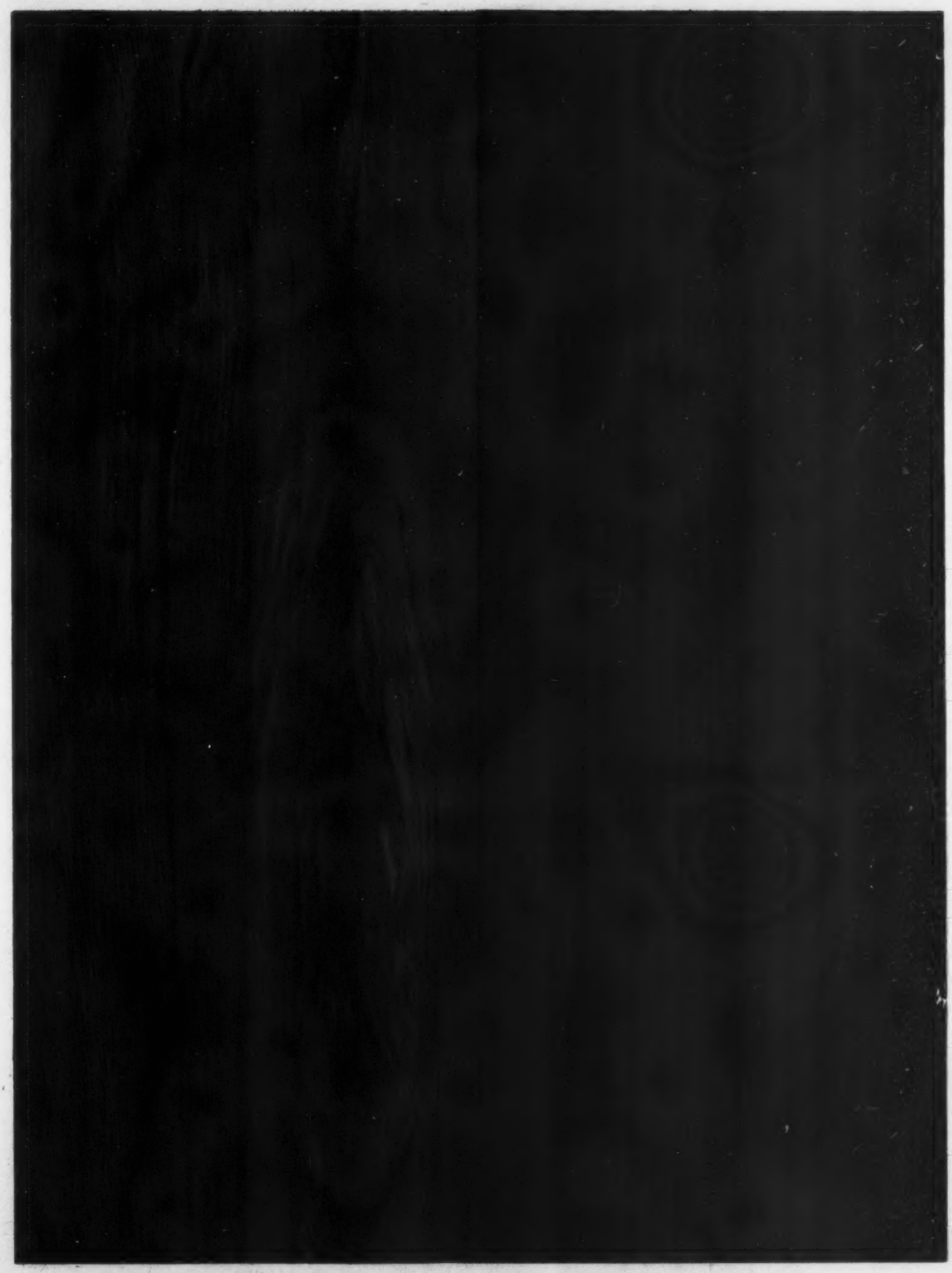
LIST OF TIMBERS ILLUSTRATED.

	Plate No.
Adenanthera pavonina	78
Adina cordifolia	70
Aegle marmelos	68
Albizzia lebbek	45, 60, 61
„ procera	59
Andamanese Marble wood	28
Aquilaria agallocha	34
Artocarpus chaplasha	42
„ integrifolia	25, 43, 44, 46
„ lakoocha	48
Bel Fruit	68
Berrya ammonilla	77
Bischofia javanica	41
Black Plum	21, 22
Blackwood	24, 26, 27
Camphor wood	38
Careya arborea	73
Cedar, Red	41
„ White	39, 40
Cedrela Toona	64
Cedrus libani var. Deodara	36, 37
Chloroxylon Swietenia	51
Chikrassia tabularis	80
Chittagong wood	80
Cinnamomum glanduliferum	38
Coromandel Ebony	82
Dalbergia latifolia	24, 26, 27
Deodar	36, 37
Diospyros ebenum	83
„ Kurzii	28
„ melanoxylon	82
Dipterocarpus Hasseltii (turbinatus)	33
Dysoxylum malabaricum	39, 40
Ebony	83
Eugenia Jambolana	21, 22
Gmelina arborea	66, 67
Gurjan Oiltree	33
Hopea parviflora	74
Ironwood of Pegu	79
Jackwood	25, 43, 44, 46
Juglans regia	81
Lagerstrœmia Flos-Reginæ	54
„ hypoleuca	58
„ lanceolata	55, 56, 57
„ tomentosa	54
Mahogany-Toon	64
Michelia champaca	31, 72
Mimusops elengi	75
Mitragyna parvifolia	69
Nepal Camphor wood	38
Planchonia valida	76
Podocarpus neriifolia	71
Pterocarpus dalbergioides	66
„ Marsupium	62, 63
Rosewood	24, 26, 27
Sandal wood	78
Satin wood	51
Schima Wallichii	52
Shorea assamica	47
„ talura	49, 50
Teak	15 to 20, 23
Tectona grandis	15 to 20, 23
Terminalia belerica	35
„ tomentosa	29, 30, 32
Trincomali wood	77
Walnut	81
Xylia dolabriformis	79

15.—Elephant piling squares of teak timber in the timber yard at the Bombay Burma Trading Corporation, Ltd., Rangoon.
(From the India Office Photographic Record).

16.—Rafts of Teak Timber on the river Rangoon, alongside saw-mill of Bombay Burma Trading Corporation, Ltd., Rangoon.
(From the India Office Photographic Record).

17.—*Tectona grandis.* Vigorous Taungya Teak Plant of six months growth. Stump of Teak Tree girdled and felled between 1830 and 1840, showing stump of new tree produced. (From a photograph lent by the Director of the Royal Gardens, Kew).

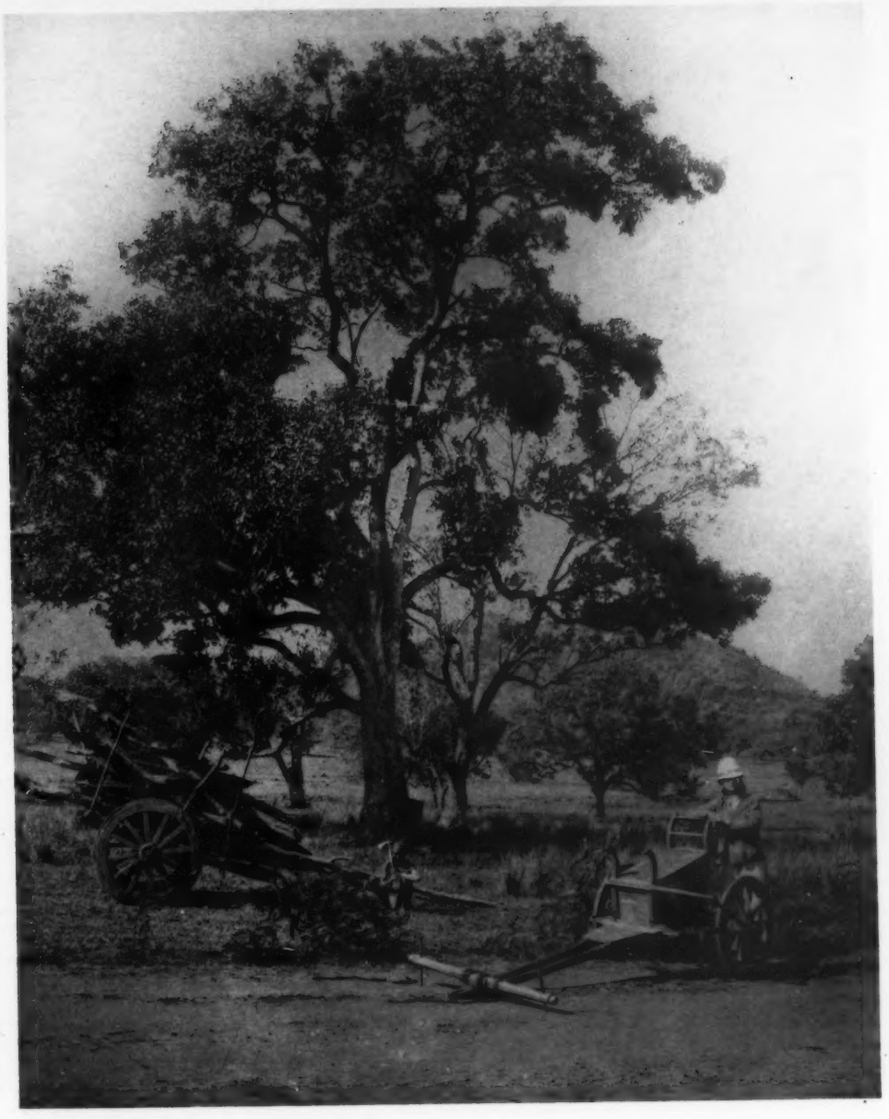


18.—*Tectona grandis, Linn.* (Teakwood or Téga.) A large deciduous tree. Wood moderately hard, strongly scented; heartwood dark golden yellow, turning brown or black with age. The Mysore Teak is noted for its durability due to the large amount of oil contained in the wood. The wood is extensively used for construction, furniture, bridges, turnery, and for all works where durability is required. Weight, about 42 lbs. per cubic foot. [Mysore Catalogue.]

19.—*Tectona grandis, Linn.* (Teakwood, India).

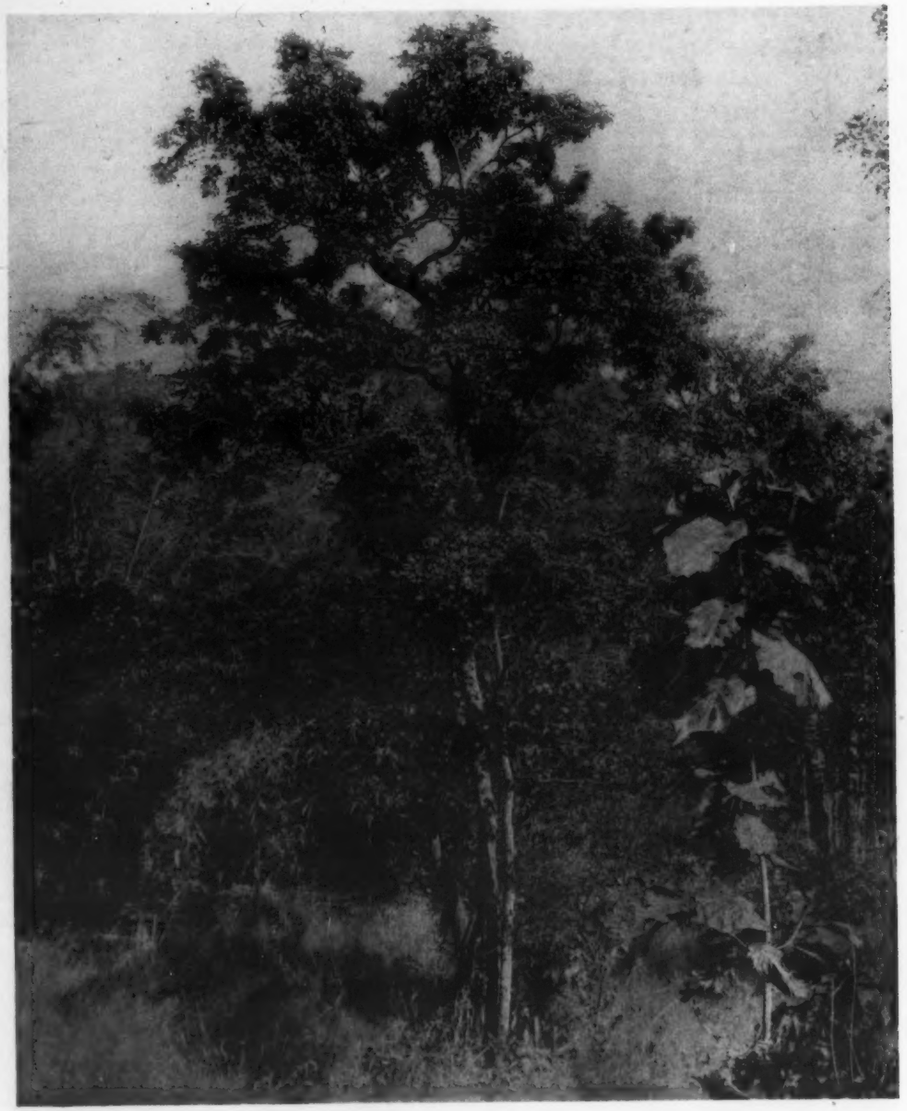
21.—*Eugenia Jambolana.* (Black Plum. Jaman.)

20.—*Tectona grandis.* (Teakwood, India).

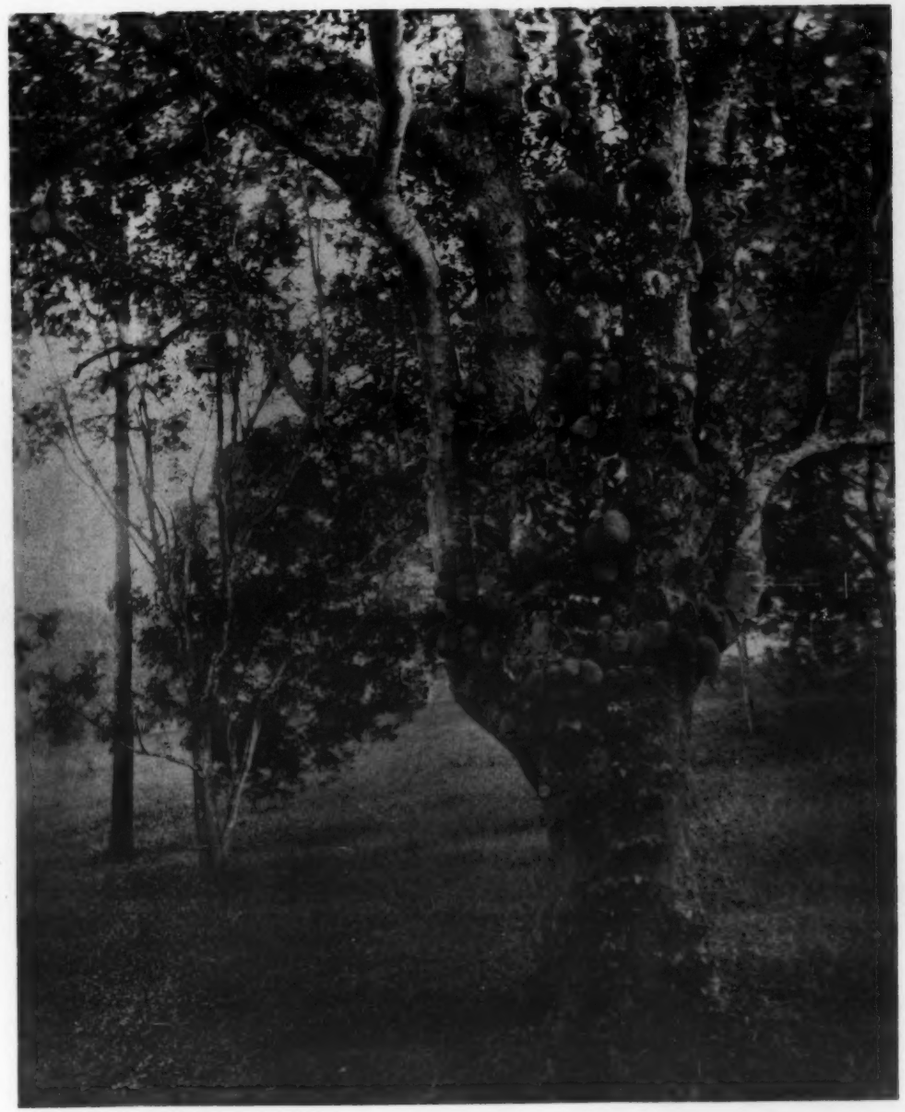


22.—*Eugenia Jambolana Tree.*

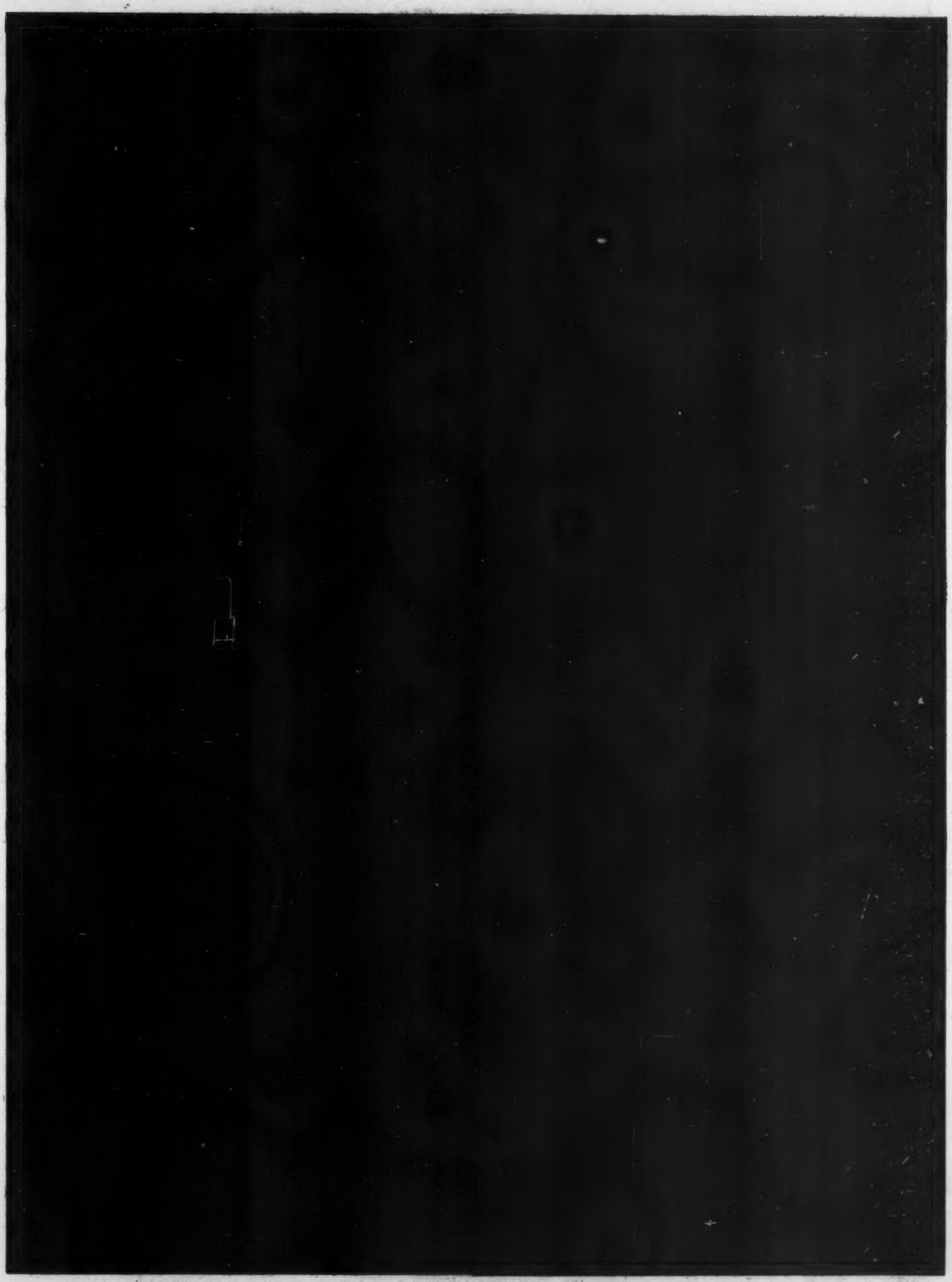
23.—Musical Instrument in Teak. (From Kew Gardens).



24.—*Dalbergia latifolia.* (Rosewood or Blackwood).
(From Kew Gardens).



25.—*Artocarpus integrifolia. Linn.* Tree in fruit. (Jack tree).
(From Kew Gardens).

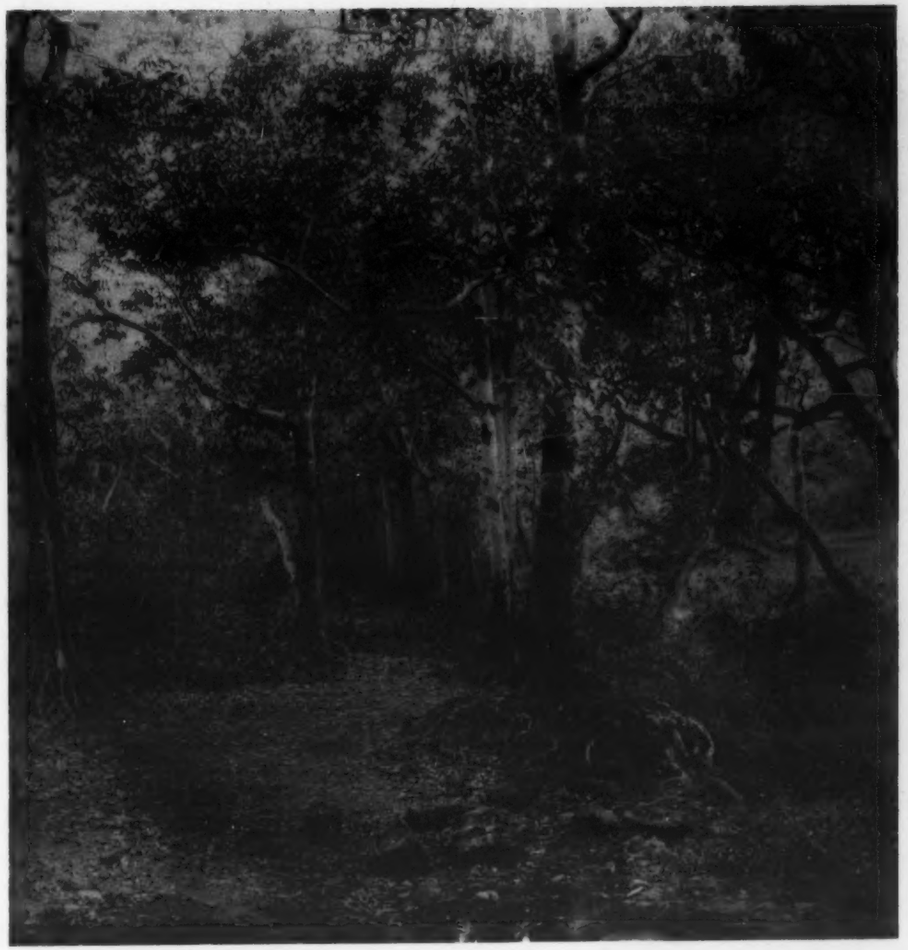


26.—*Dalbergia latifolia*, (Rosewood or Blackwood or Beeti.) A deciduous tree, attaining a large size in Mysore, and is widely distributed in the forests of Shimoga, Kadur and Mysore Districts. Wood extremely hard, fine grained; heartwood dark purple with black longitudinal streaks. This tree affords a valuable furniture wood. It is the rosewood of commerce, used for cart wheels, for spokes of gun carriage wheels, and for door and window frames. Weight, about 50 lbs. per cubic foot. [Mysore Catalogue.]

28.—*Diospyros Kurzii.* (Andamanese Marble Wood).

27.—*Dalbergia latifolia.* (Rosewood or Blackwood)

29.—*Terminalia tomentosa.* (Asna or Saj).
(From Kew Gardens).

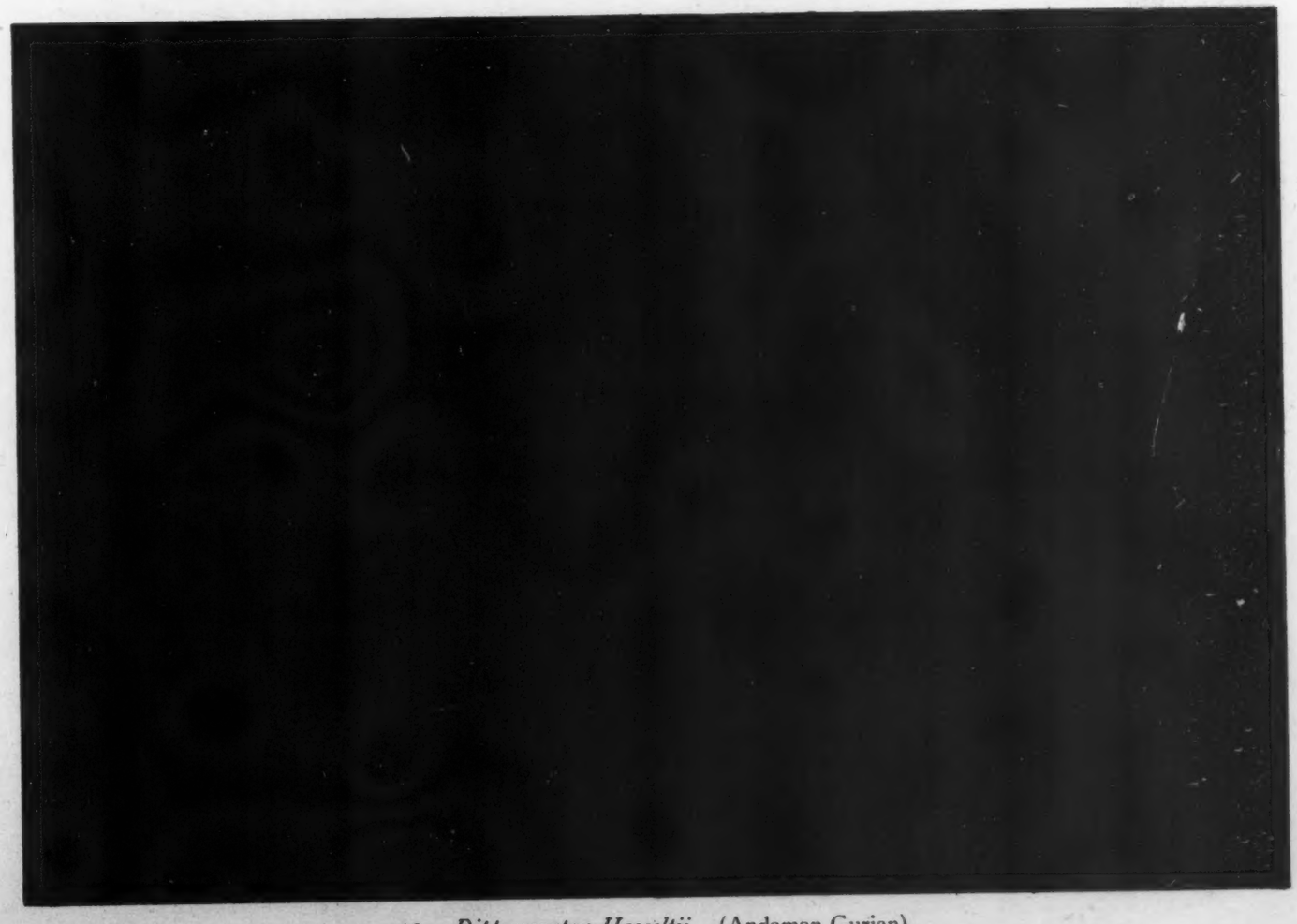


31.—*Michelia Champaca.* (Champa).
(From Kew Gardens).

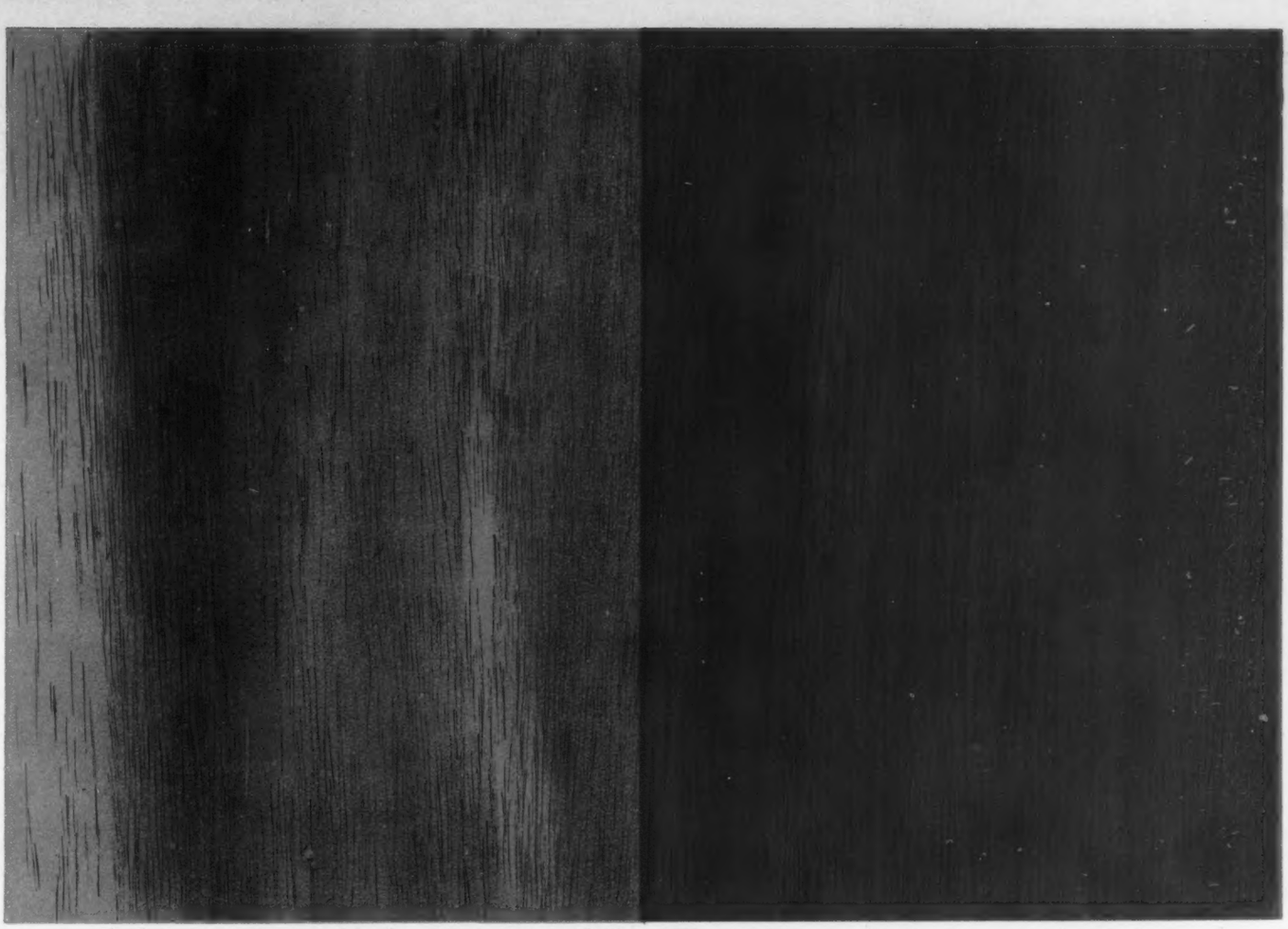
30.—*Terminalia tomentosa.* Sapwood reddish white, heartwood dark-brown, hard, beautifully variegated with streaks of darker colour, shewing on a radial section as dark streaks which are generally wavy or undulating; durable, seasons well, and takes a good polish. Weight about 71 lbs. per cubic foot.

The wood is largely used for house-building, carts, rice-pounders, ships and boat building. It has been successfully tried for railway sleepers. F. B. MANSON.

32.—*Terminalia tomentosa.* (Asna or Saj).



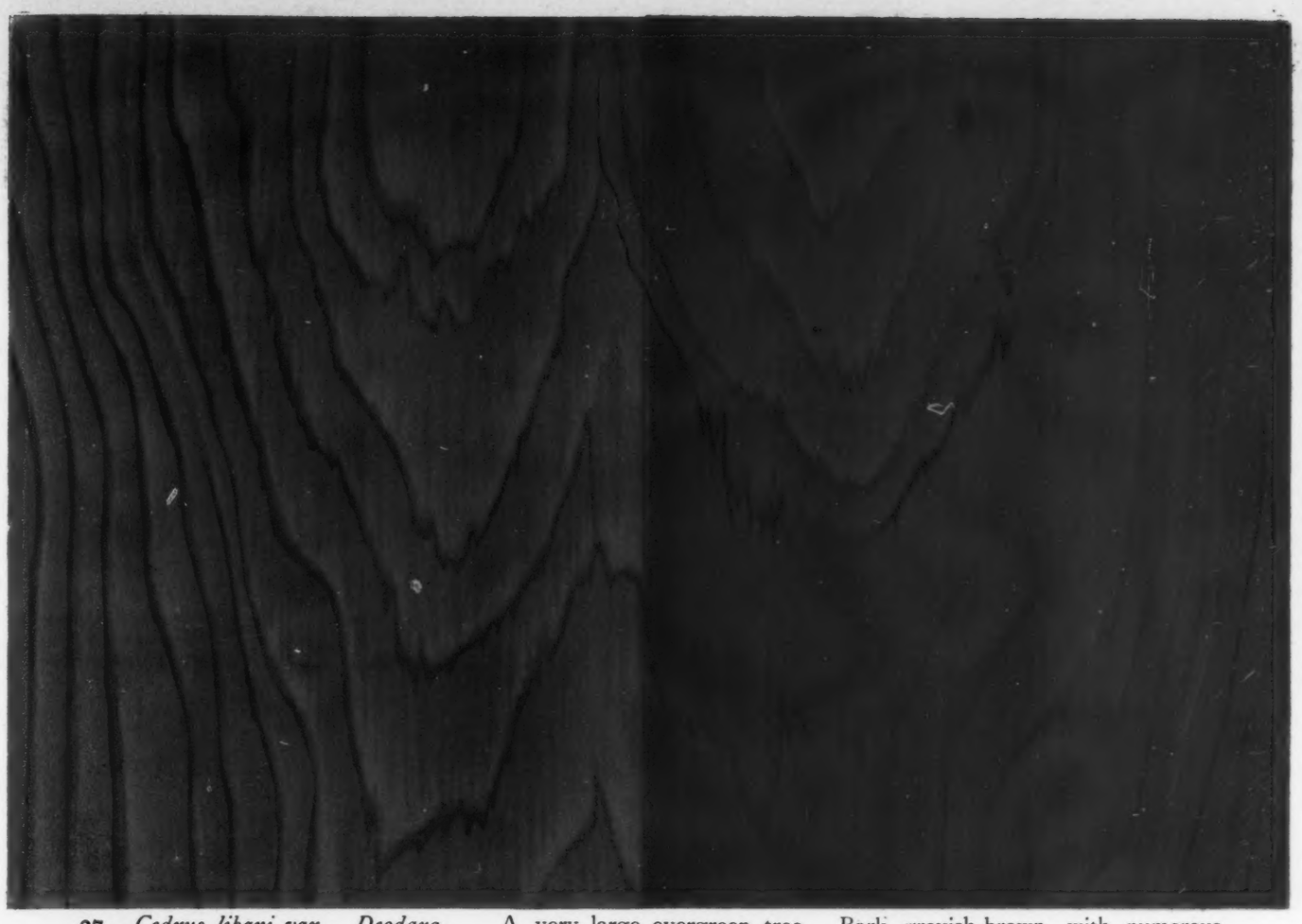
33.—*Dipterocarpus Hasseltii.* (Andaman Gurjan).



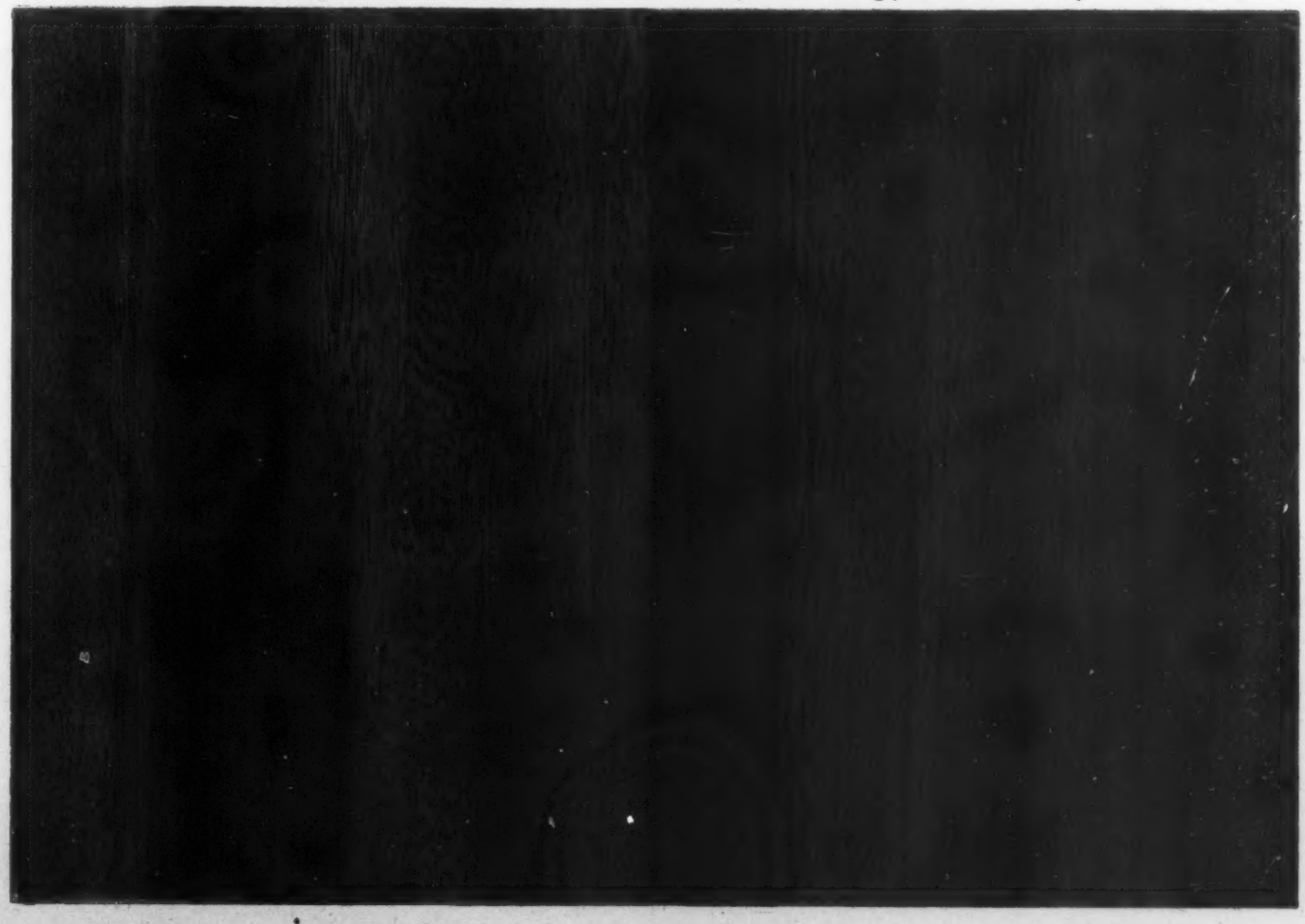
34.—*Aquilaria agallocha.* A large evergreen tree of Sylhet. Wood soft, even-grained, and scented when fresh cut. In old trees are masses of harder and darker wood, which is the famous Eagle-wood of commerce. MANSON.

35.—*Terminalia belerica.* A large deciduous tree growing in the forests of India and Burma. Wood yellowish-grey, hard, no heartwood. Weight about 48 lbs. per cubic foot. MANSON.

36.—*Deodara Forest; N.W. Himalaya.* Between 4,000 and 10,000 feet above sea-level, extending east to the Daulî river, in the mountains of Afghanistan and North Beluchistan. The tree is very large and tall, with heartwood light yellowish-brown, scented, and moderately hard. In each annual ring the outer belt of firmer and darker coloured tissue is generally narrow. MANSON.

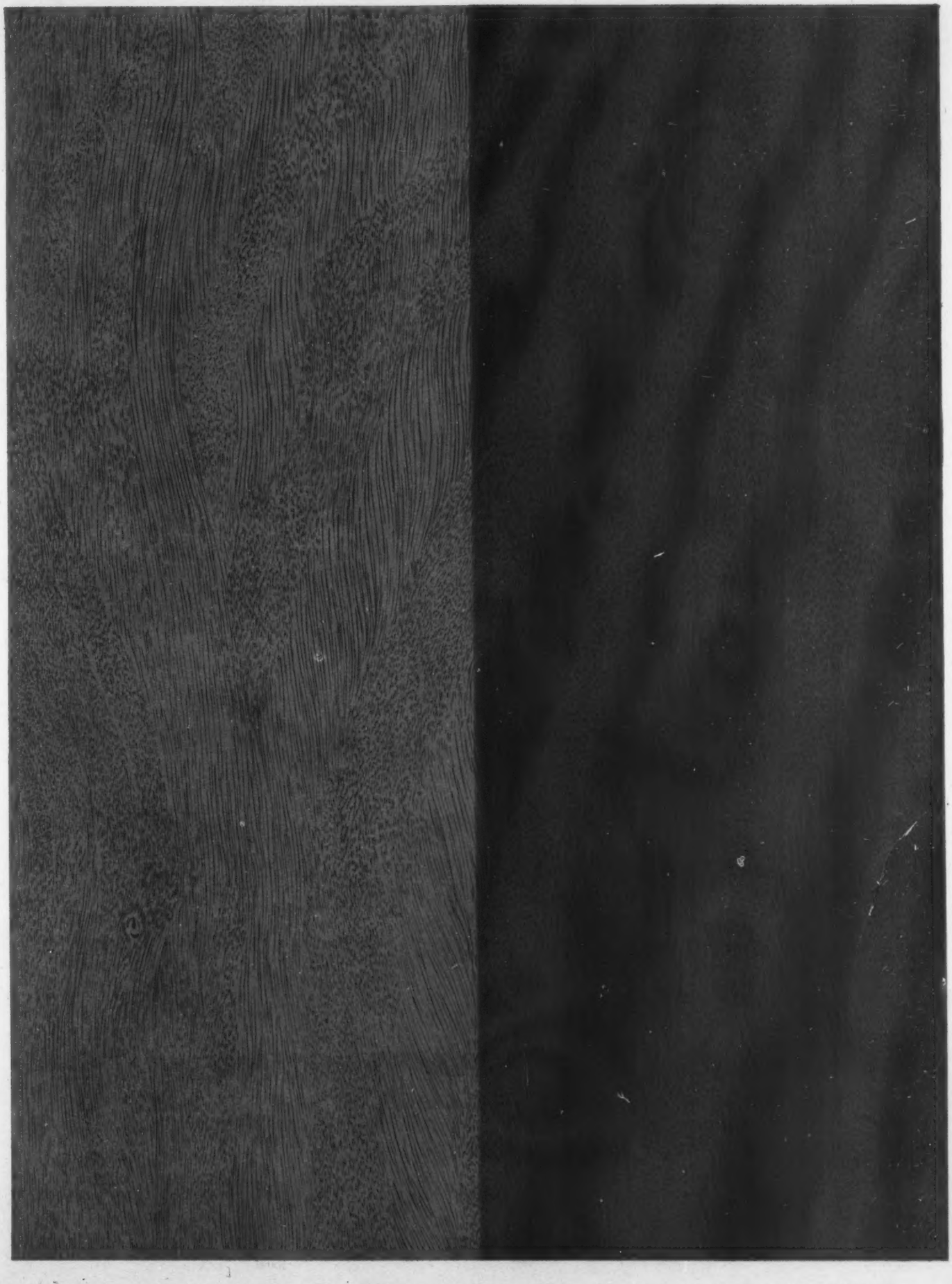


37.—*Cedrus libani var. Deodara.* A very large evergreen tree. Bark greyish-brown, with numerous fissures, which give a reticulate appearance. Wood fairly hard, strongly scented, and oily. GAMBLE.



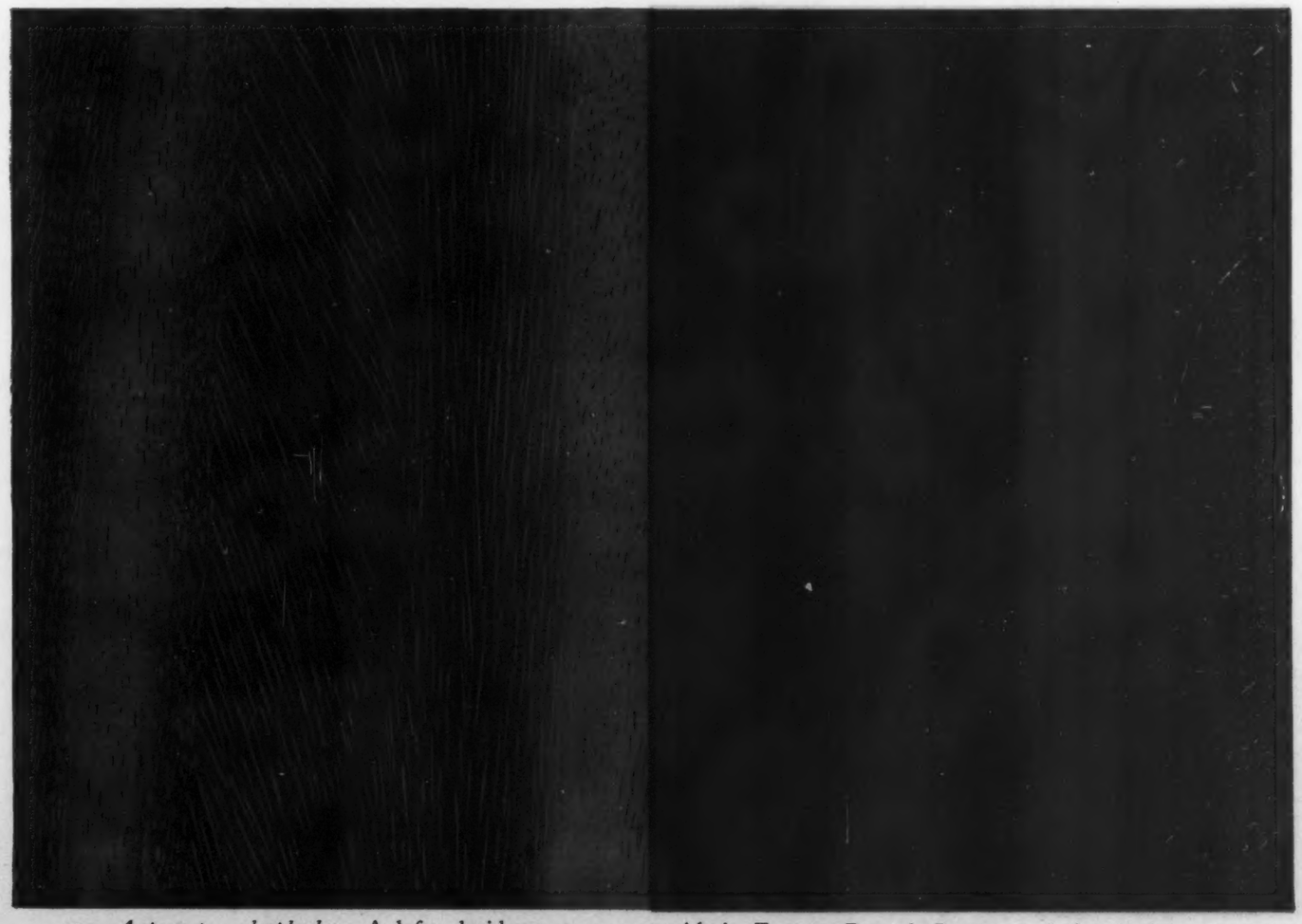
38.—*Cinnamomum glanduliferum.* (Nepal Camphor wood.) A large tree of South Himalaya and Assam. Wood rough, pale-brown, and highly scented, with a strong smell of camphor when fresh cut. MANSON.

39.—*Dysoxylum malabaricum.* (White Cedar.) A very large tree. The colour of the wood is white, shading to yellow. It is beautifully grained, takes a good polish, and is most suitable for cabinet work. [Mysore Catalogue.]

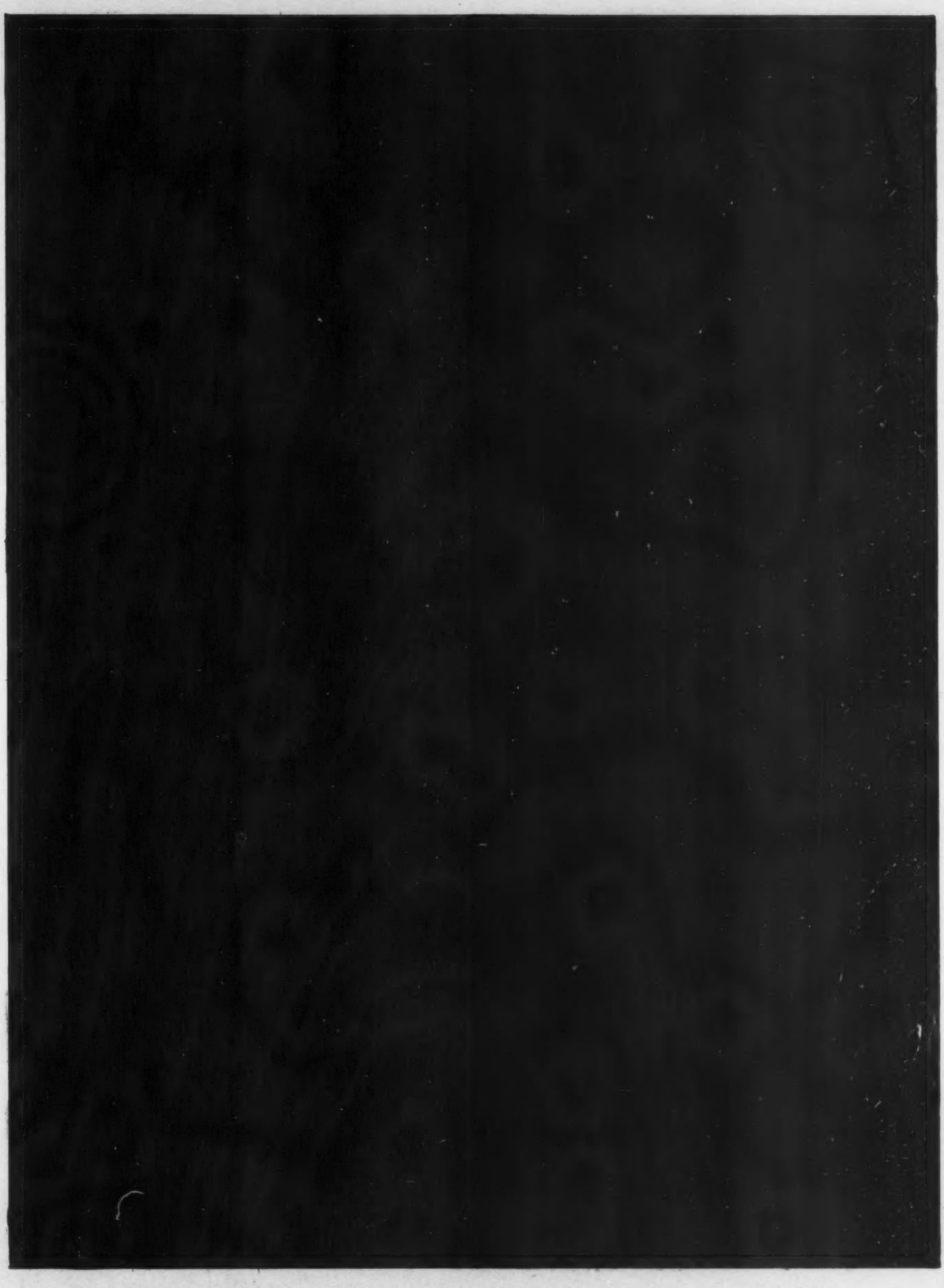


40.—*Dysoxylum malabaricum. Coorg.* A very large tree. Wood hard, close-grained, and elastic. Pores moderate-sized, numerous, and evenly distributed, sometimes in fine concentric white lines. Medullary rays fine, and numerous. GAMBLE.

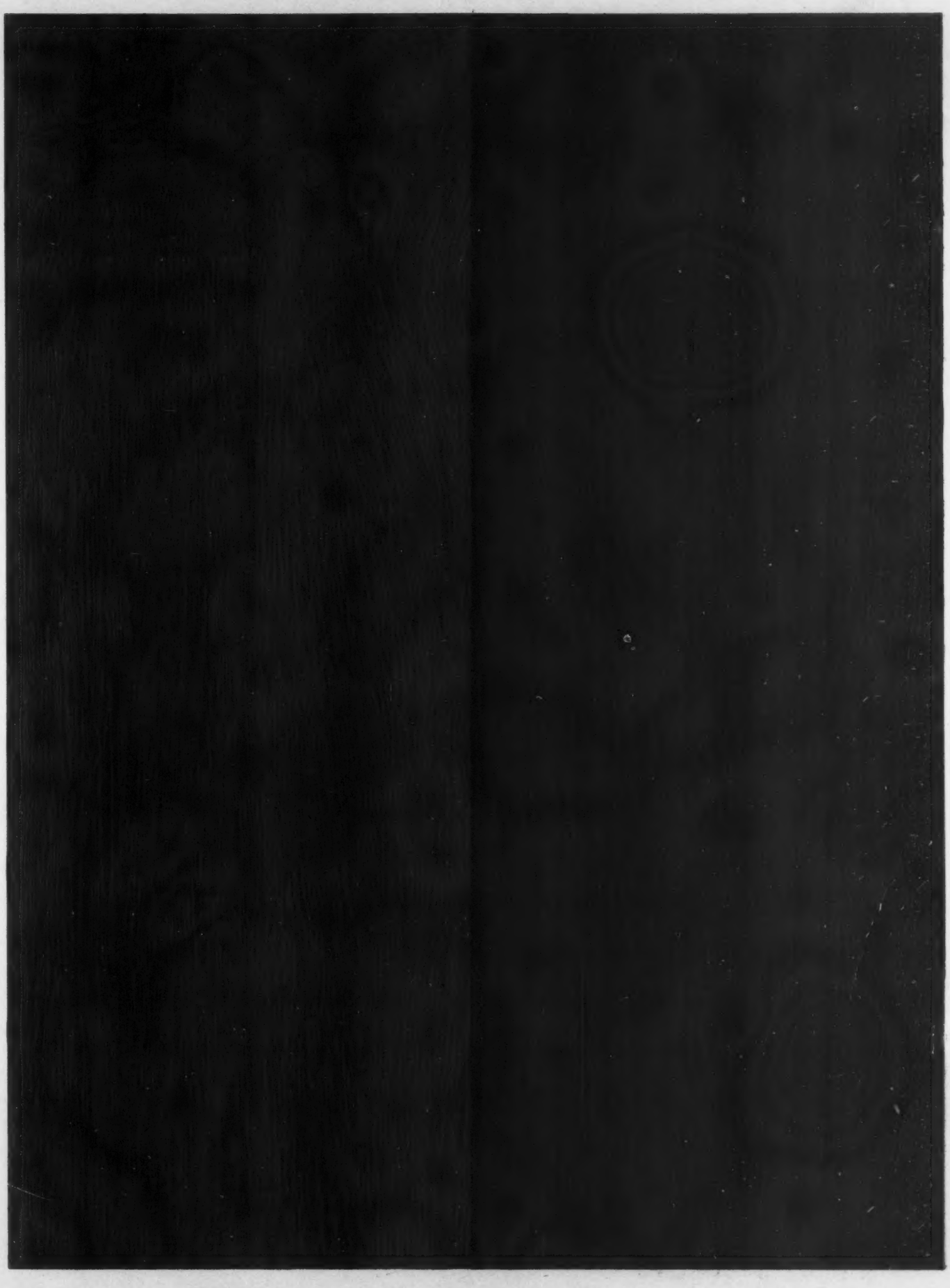
41.—*Bischofia javanica.* (Red Cedar.) A deciduous tree found in Kumaun and Burma. Weight 47½ lbs. per c. ft. Wood rough, and moderately hard. In Assam it is highly esteemed and used for bridges &c. MANSON.



42.—*Artocarpus chaplasha.* A lofty deciduous tree, met with in Eastern Bengal, Burma, and the Andaman Islands. Wood yellow to brown, moderately hard, even-grained, rough, durable, and seasons well. MANSON.



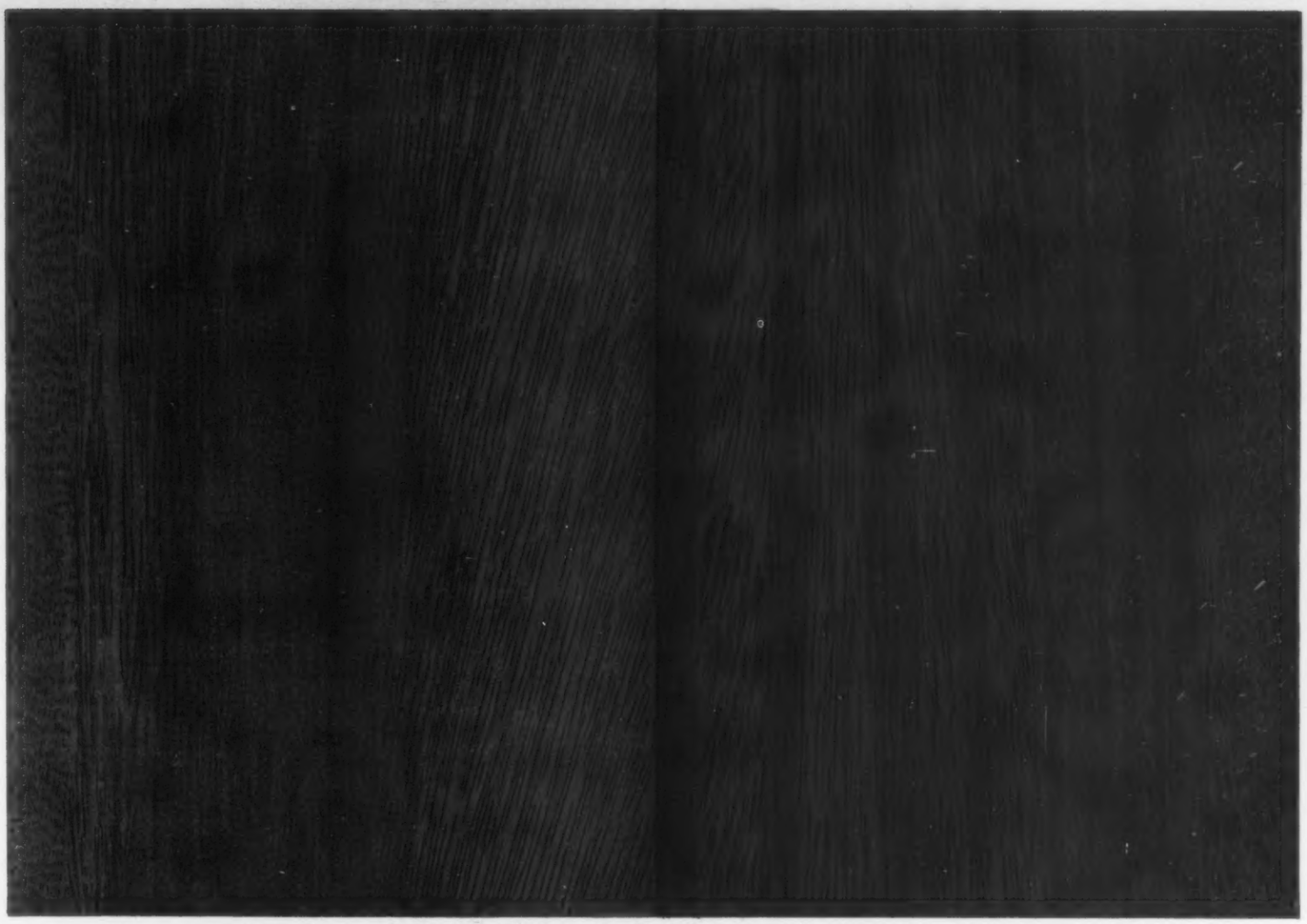
43.—*Artocarpus integrifolia. Linn.* A large tree, cultivated throughout India, except in the northernmost part. Wild in the mountain forests of the Western Ghâts, ascending to 4,000 feet above sea-level. (Beddome). Heartwood yellow or rich yellowish-brown, darkening on exposure, compact, even-grained, moderately hard, seasons well and takes a fine polish. Weight about 40 lbs. per cubic foot. It is largely used for carpentry, boxes and furniture, and is exported to Europe for cabinet work, turning, and brush-backs. MANSON.



44.—*Artocarpus integrifolia.* A very large evergreen tree. Wood moderately hard; heartwood bright yellow, darkening on exposure. The wood is used for furniture, boxes, planking, and cabinet work. Weight about 33 lbs. per cubic foot. [Mysore Catalogue.]

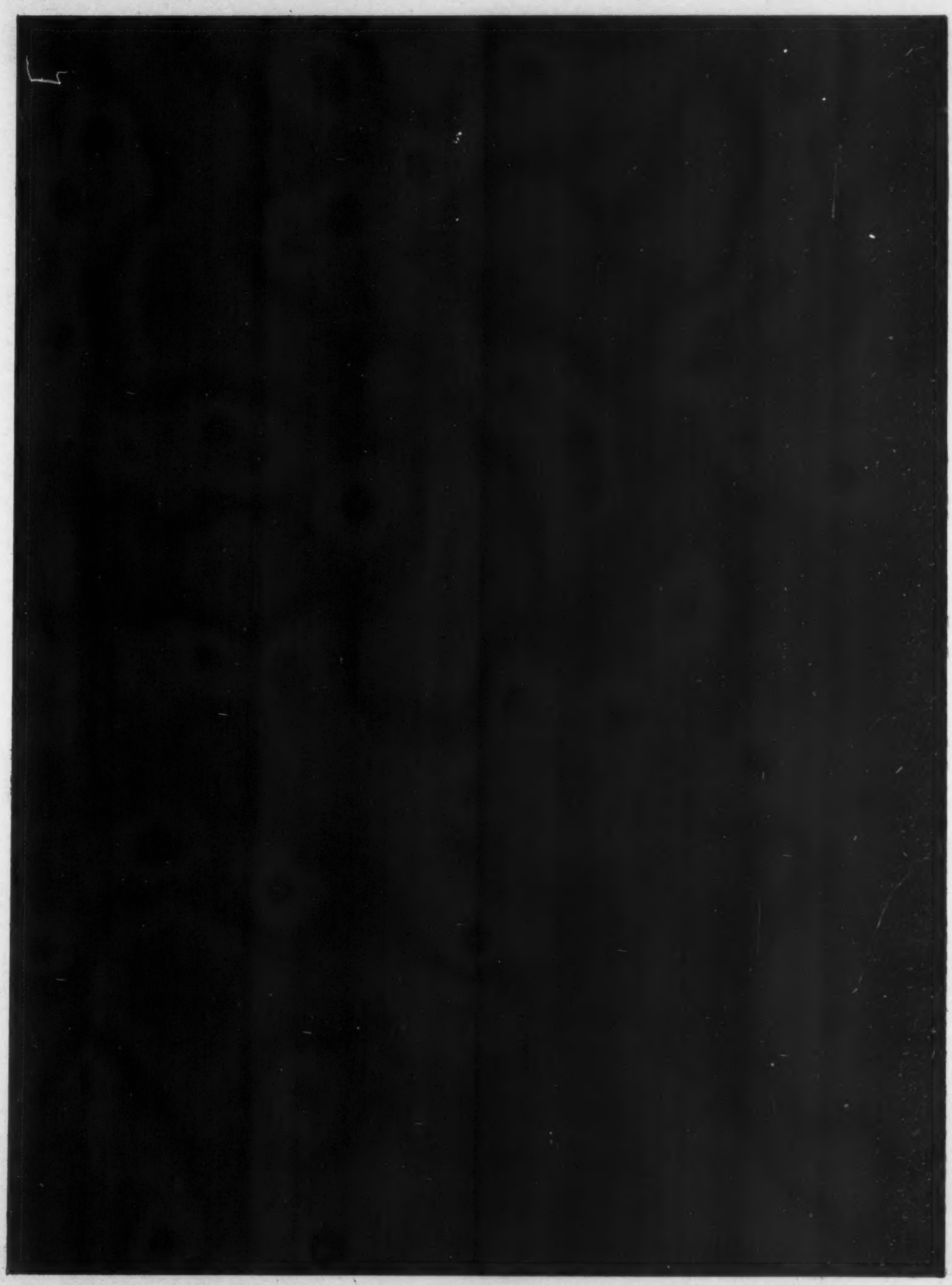
45.—*Albizzia lebbek.* A very large tree. Wood hard; heartwood dark reddish-brown, marked with darker streaks. Takes a high polish; used for sugarcane crushers, furniture, and carts. [Mysore Catalogue.]

46.—*Artocarpus integrifolia.* (Jackwood.) A large evergreen tree. Bark thick, blackish, and deeply cleft when old. Wood moderately hard; sapwood pale; heartwood bright yellow, darkening on exposure. GAMBLE.

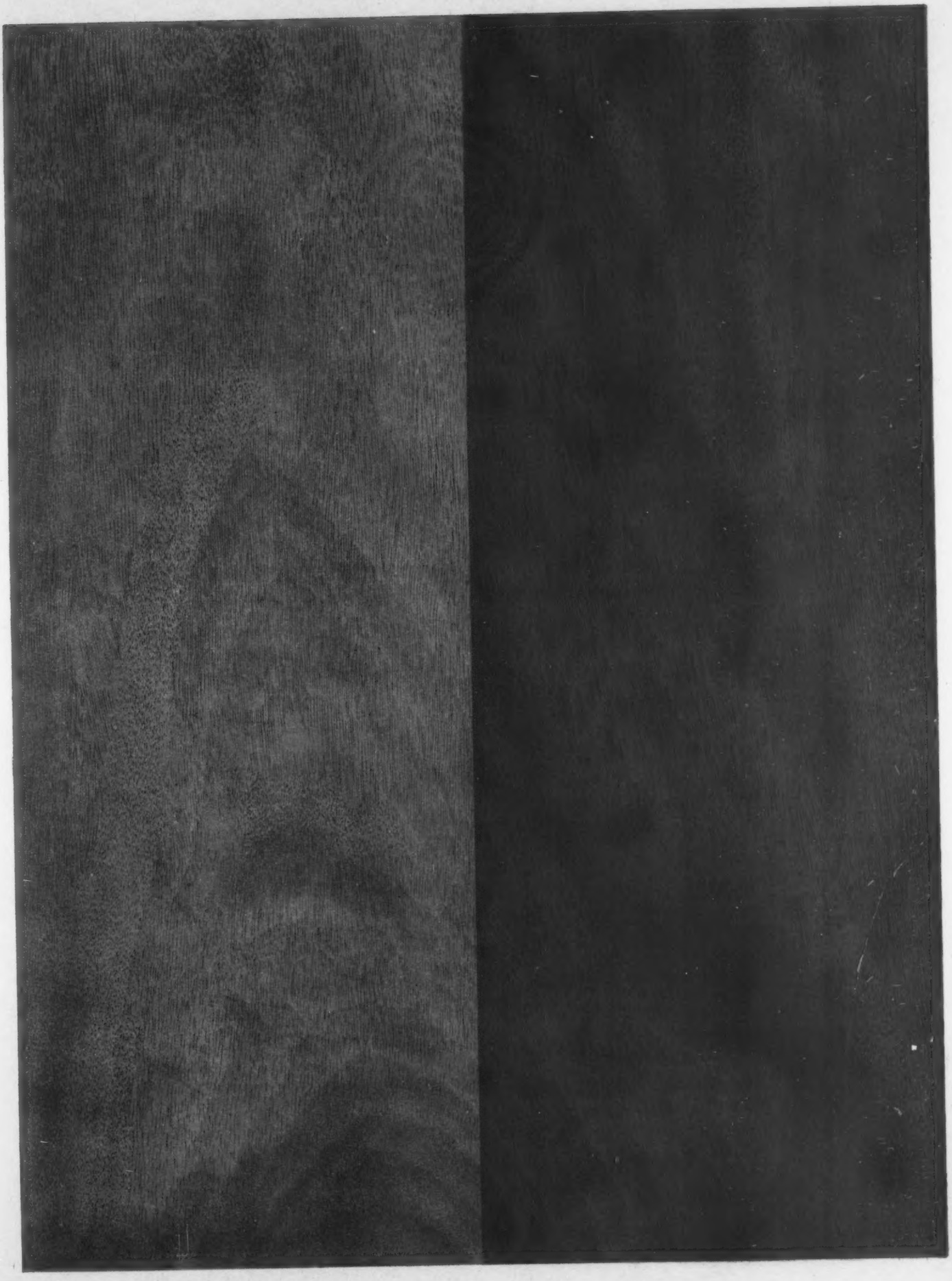


47.—*Shorea assamica*. A very large gregarious tree. Bark brown, and rough. Wood light-brown, soft, and open-grained. Pores large, ringed, single, in groups, or in short oblique lines. GAMBLE.

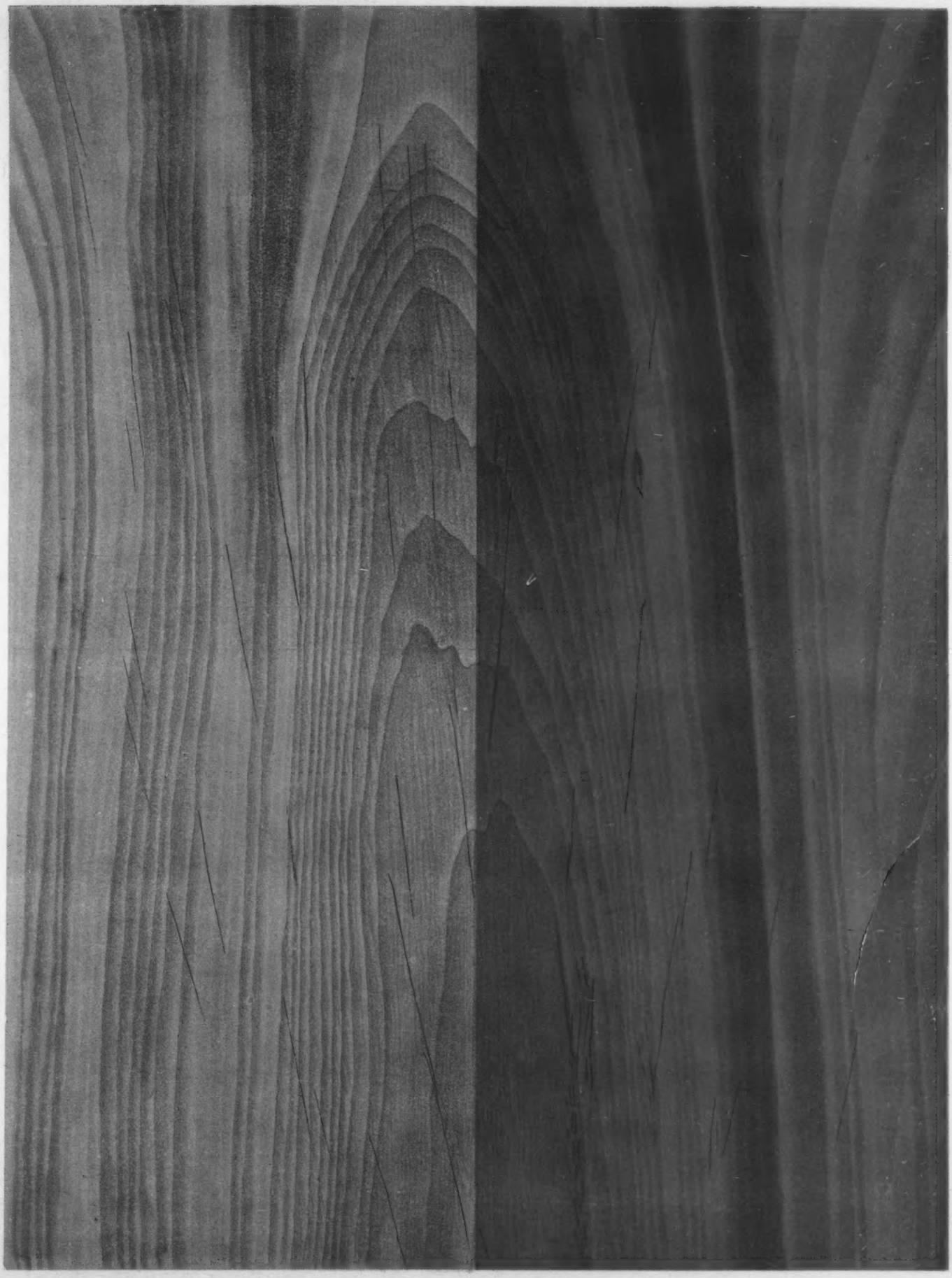
48.—*Artocarpus lakoocha*. Found in Sikkim, Eastern Bengal, Burma, and in the evergreen forests of the Western Ghâts and Ceylon. Seasons well, and takes a good polish. Weight 30 to 50 lbs. per cubic foot. Used for furniture and canoes. MANSON.



49.—*Shorea talura.* A large tree; wood yellow or yellowish-brown, hard and smooth. This handsome tree is found largely in the Kadur District and sporadically in Mysore and Shimoga Districts. The wood is much used for house-building and is exported to the Kolar Gold Fields. Weight about 53 lbs. per cubic foot. [Mysore Catalogue.]



50.—*Shorea talura.*

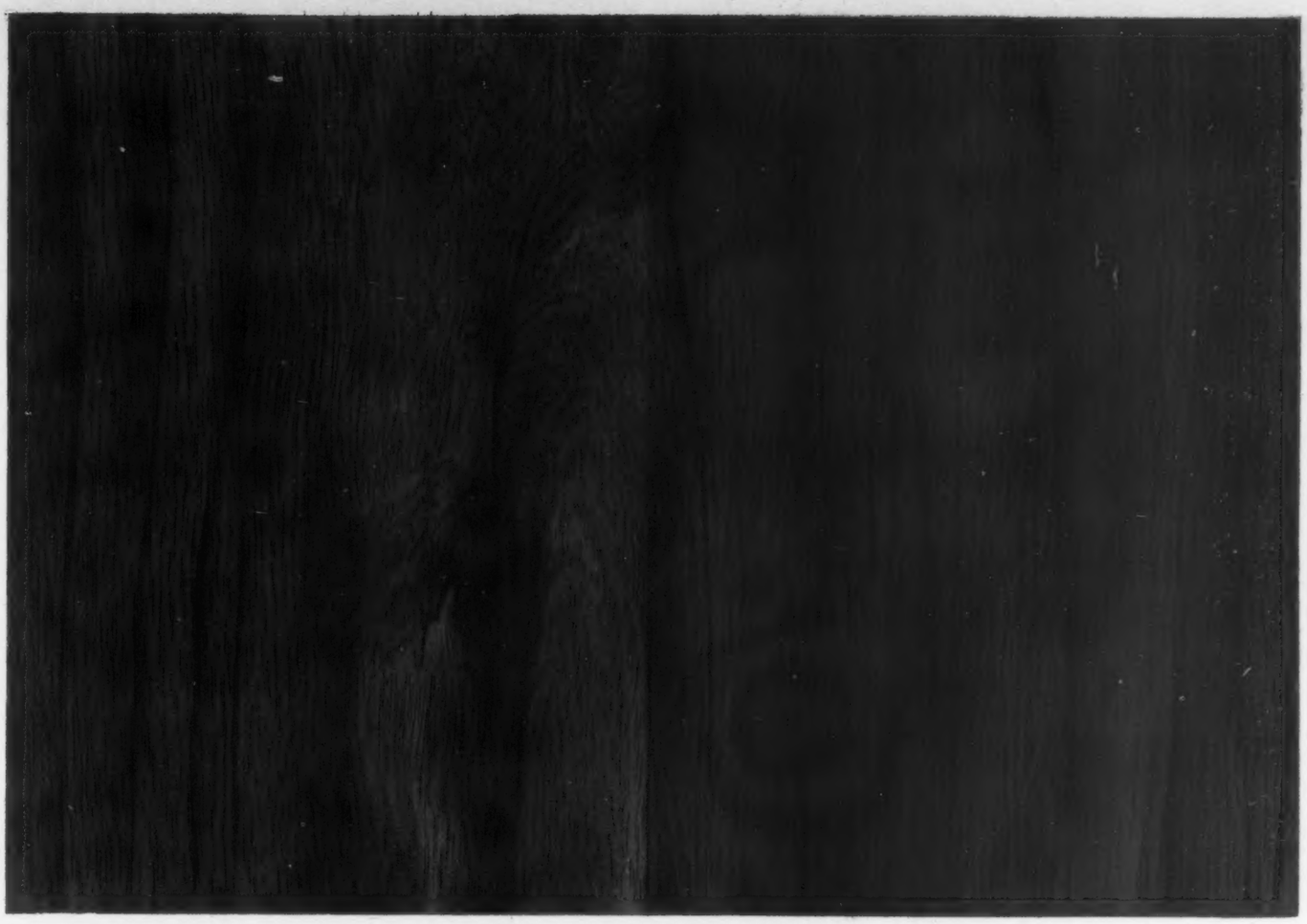


51.—*Chloroxylon Swietenia, D.C.* Satinwood or Hurugalu. A moderate-sized deciduous tree, found in Central and South India, also in Ceylon. Wood very hard, yellowish-brown, (the inner wood of a darker colour), with a beautiful satiny lustre. It is used for agricultural inplements, cart building, furniture, picture frames, turning, and cabinet making; and is found to stand well under water. Weight, about 62 lbs. per cubic ft.

52.—*Schima Wallichii.* Makusal-Chilauni. A large evergreen tree. Wood red, or reddish-brown, moderately hard. Weight 44 lbs. per cub. ft. Used chiefly for building, also for canoes and ploughshares. GAMBLE.

53.—*Lagerstræmia tomentosa.* Laieya.

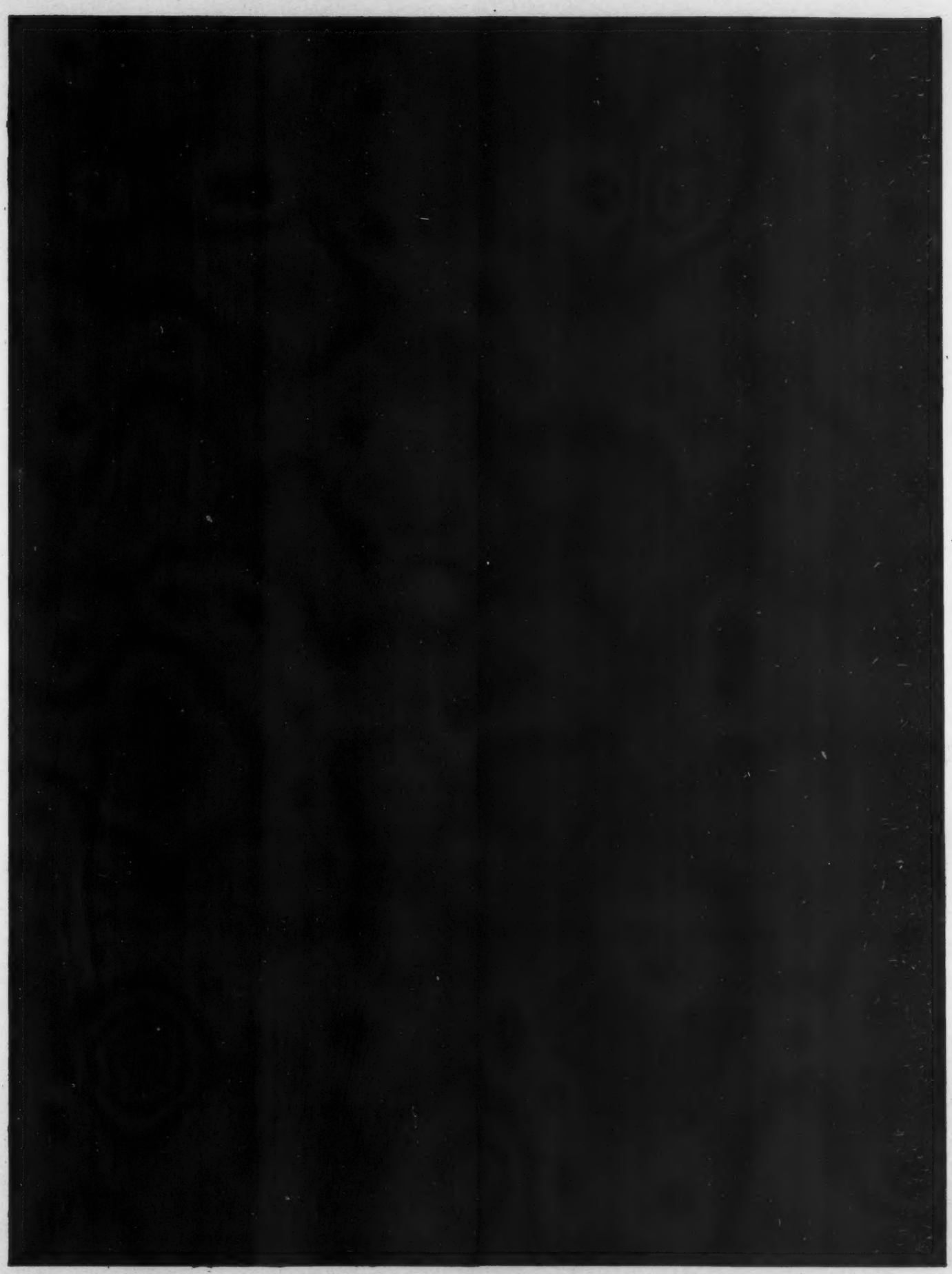
A large deciduous tree. Wood moderately hard. Used for bows, spear-handles, canoes and cart-wheels. GAMBLE.



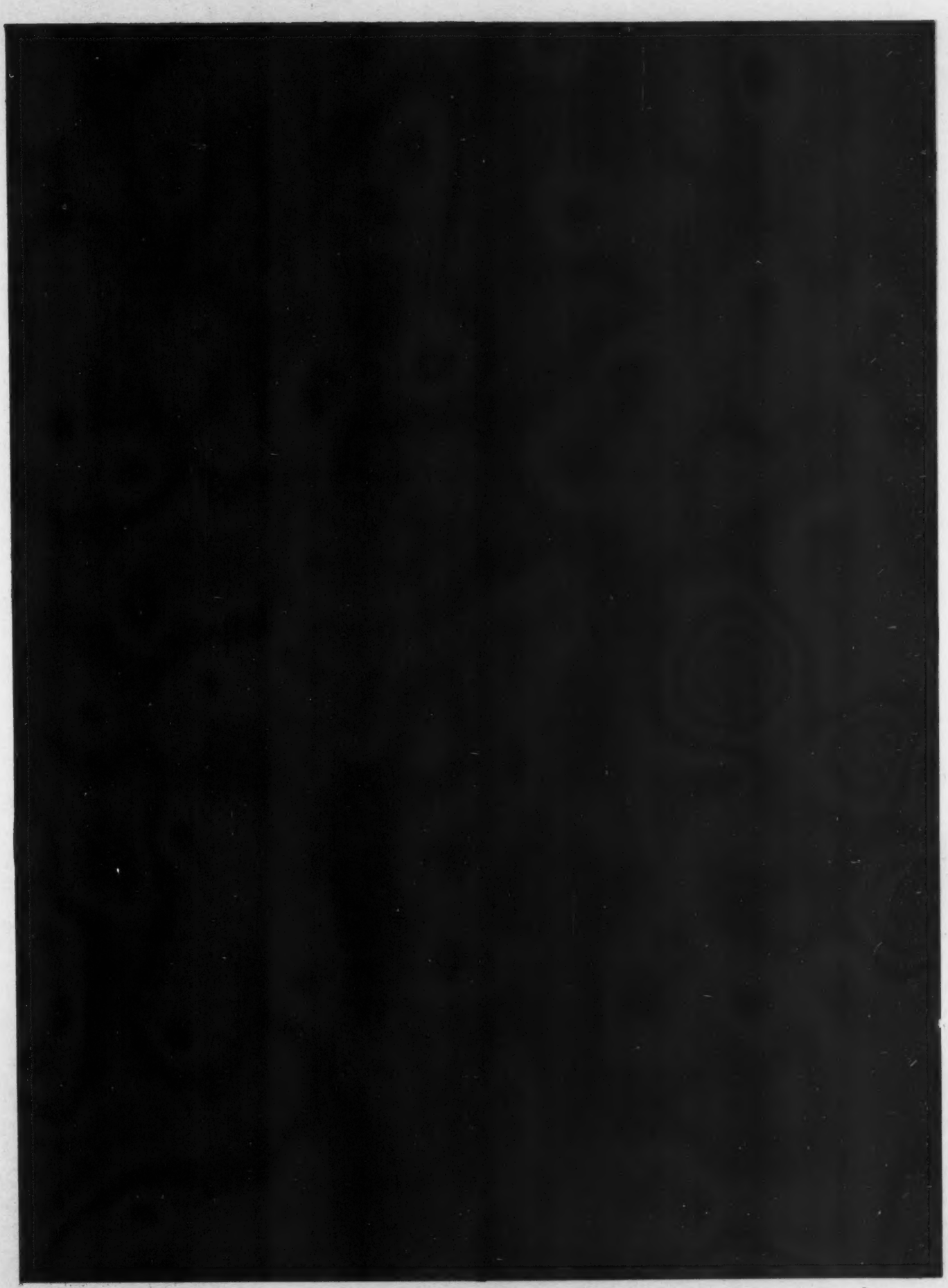
54.—*Lagerstræmia Flos-Reginæ.* Arjuna or Jarul. Large deciduous tree. Wood hard. Used for ships, boats, building, carts; in Ceylon for casks. Main timber of E. Bengal, Chittagong, Burma, but becoming scarce. GAMBLE.

55.—*Lagerstræmia lanceolata.* . Boda or Bentaek.

(For description see plate 56.)



56.—*Lagerstrœmia lancéolata.* Nandi A very large deciduous tree, common in the forests of Kadur and Shimoga Districts. Wood red or reddish brown and moderately hard. It is a valuable timber tree, and grows to a very large size. It is used for building purposes, carts, coffee cases and furniture. Weight about 42 lbs. per cubic foot. [Mysore Catalogue.]

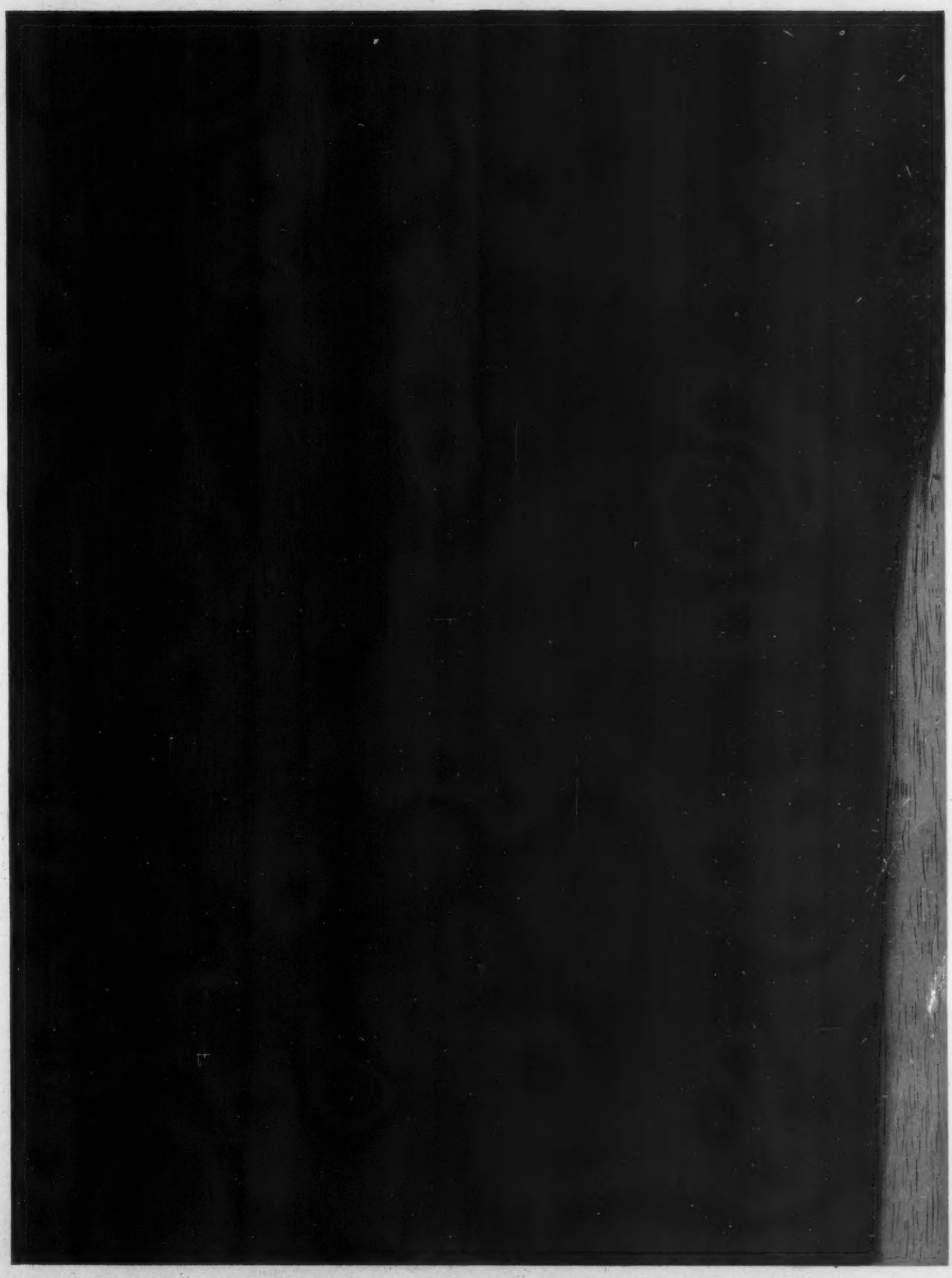


57.—*Lagerstræmia lanceolata.*

58.—*Lagerstræmia hypoleuca.* Pymmah. A large deciduous tree. Wood red, hard, used for shingles, posts, floors, spokes and felloes of cart wheels. Durable and seldom attacked by white ants. GAMBLE.

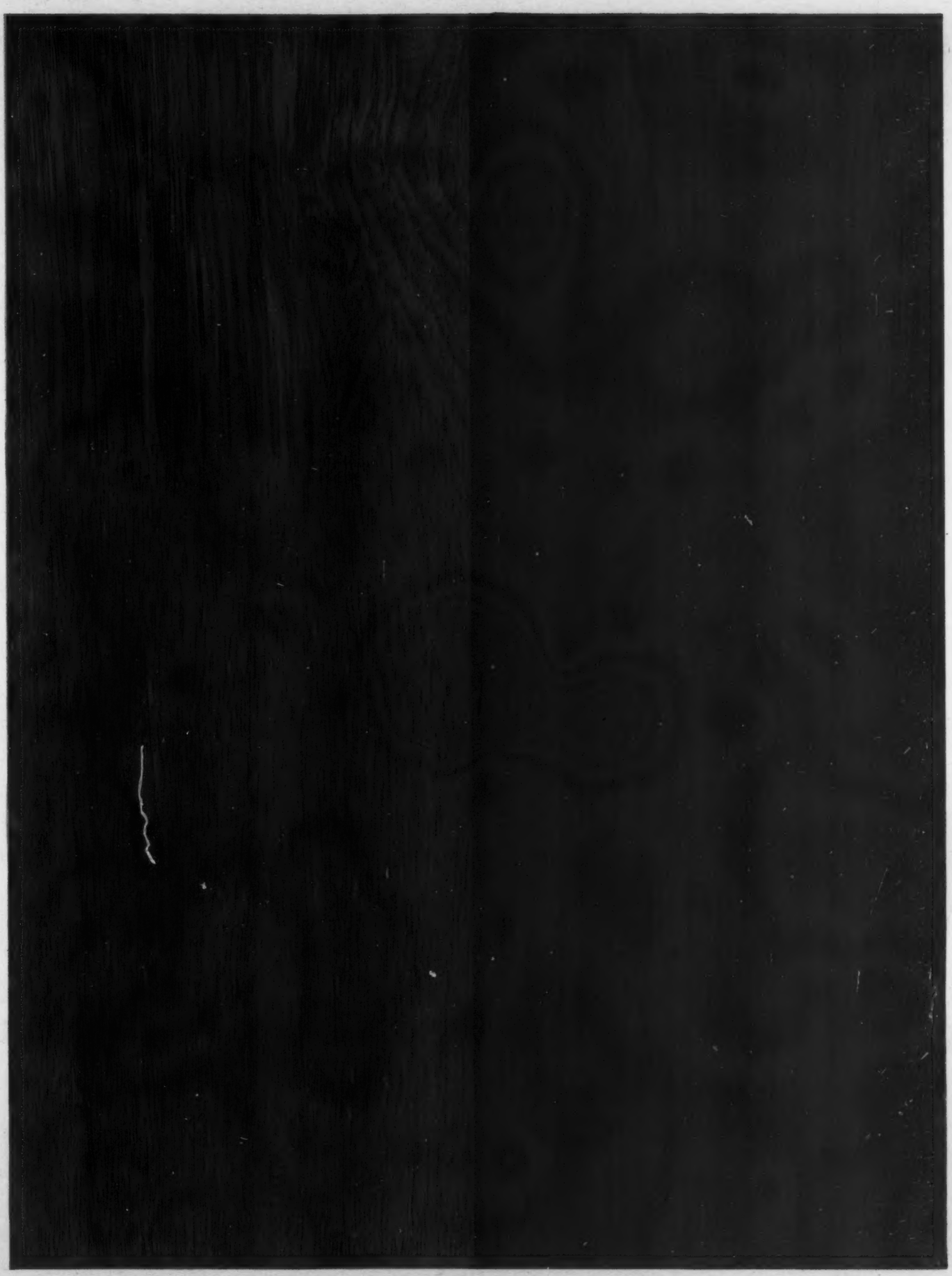
59.—*Albizzia procera.* Safed Siris.

A large deciduous tree. Wood hard. Good for fuel. Used for sugar-cane crushers, rice pounders, wheels, agricultural implements, bridges, stakes for tea-planting. Makes good charcoal and gives a copious gum. GAMBLE.

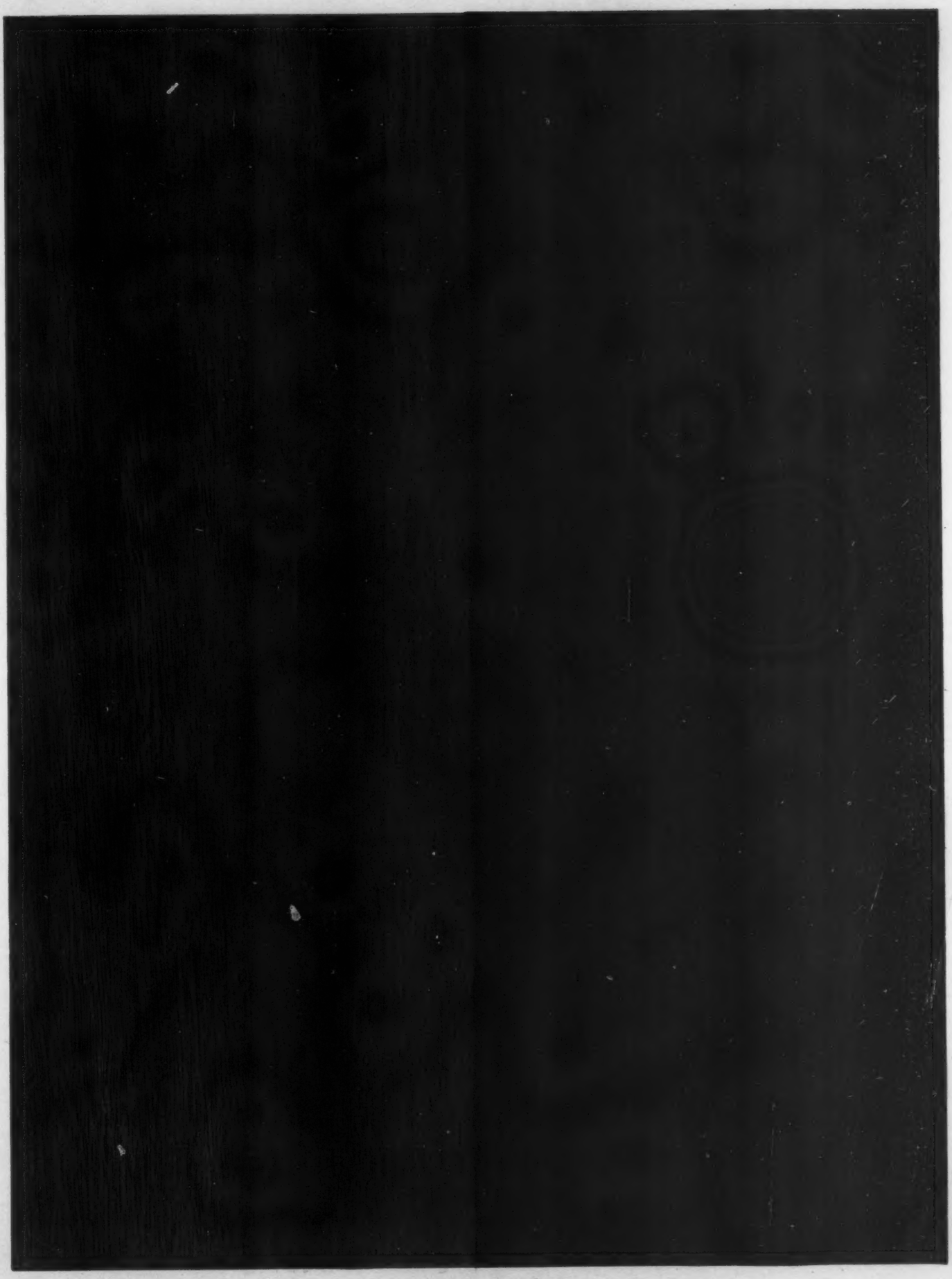


60.—*Albizzia Lebbek.* A large deciduous tree. Wood hard. Used for sugar-cane crushers, oil-mills, furniture, well curbs and wheels; in S. India for boats. It is probably the "East Indian Walnut" of the European market. GAMBLE.

61.—*Albizzia Lebbek.*



62.—*Pterocarpus Marsupium, Roxb.* (Honnê.) A large deciduous tree, common in Mysore and Shimoga forests. Wood very hard, close grained ; tough and strong, heartwood yellowish brown with darker streaks. This wood is durable, seasons well, and takes a fine polish. It is much used for door and window frames, posts and beams, cart and boat building. From wounds in the bark it yields a red gum resin called "Kino," much used in medicine. The average weight is about 48 lbs. per cubic foot. [Mysore Catalogue.]

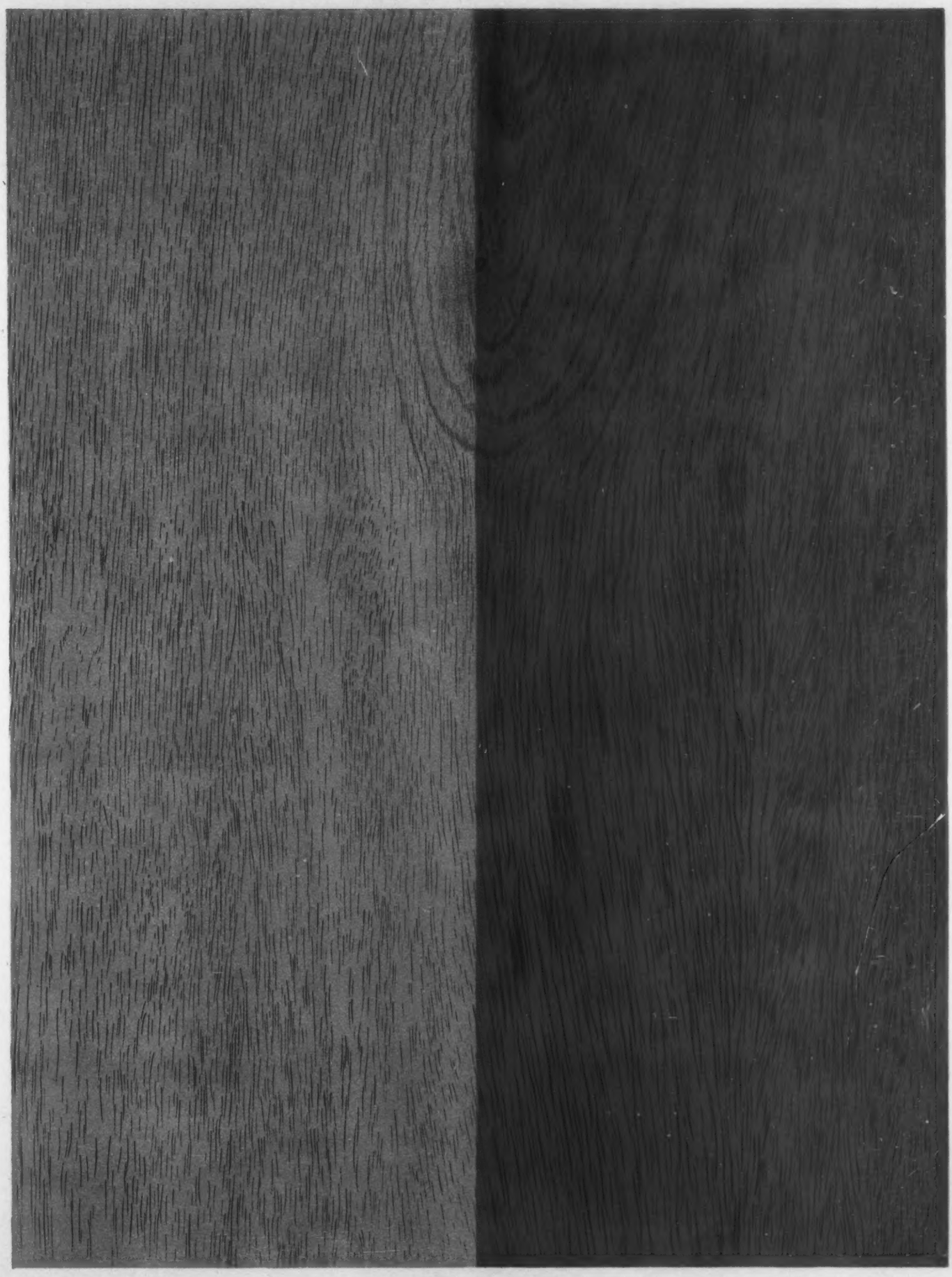


63.—*Pterocarpus Marsupium.*

64.—*Cedrela Toona.* Indian Mahogany-Toon. Deciduous. Wood soft, does not split or warp. Wt. 35 lbs. per cub. ft. Durable, not eaten by white ants. Used for furniture, door-panels, carving, tea & cigar-boxes. GAMBLE.

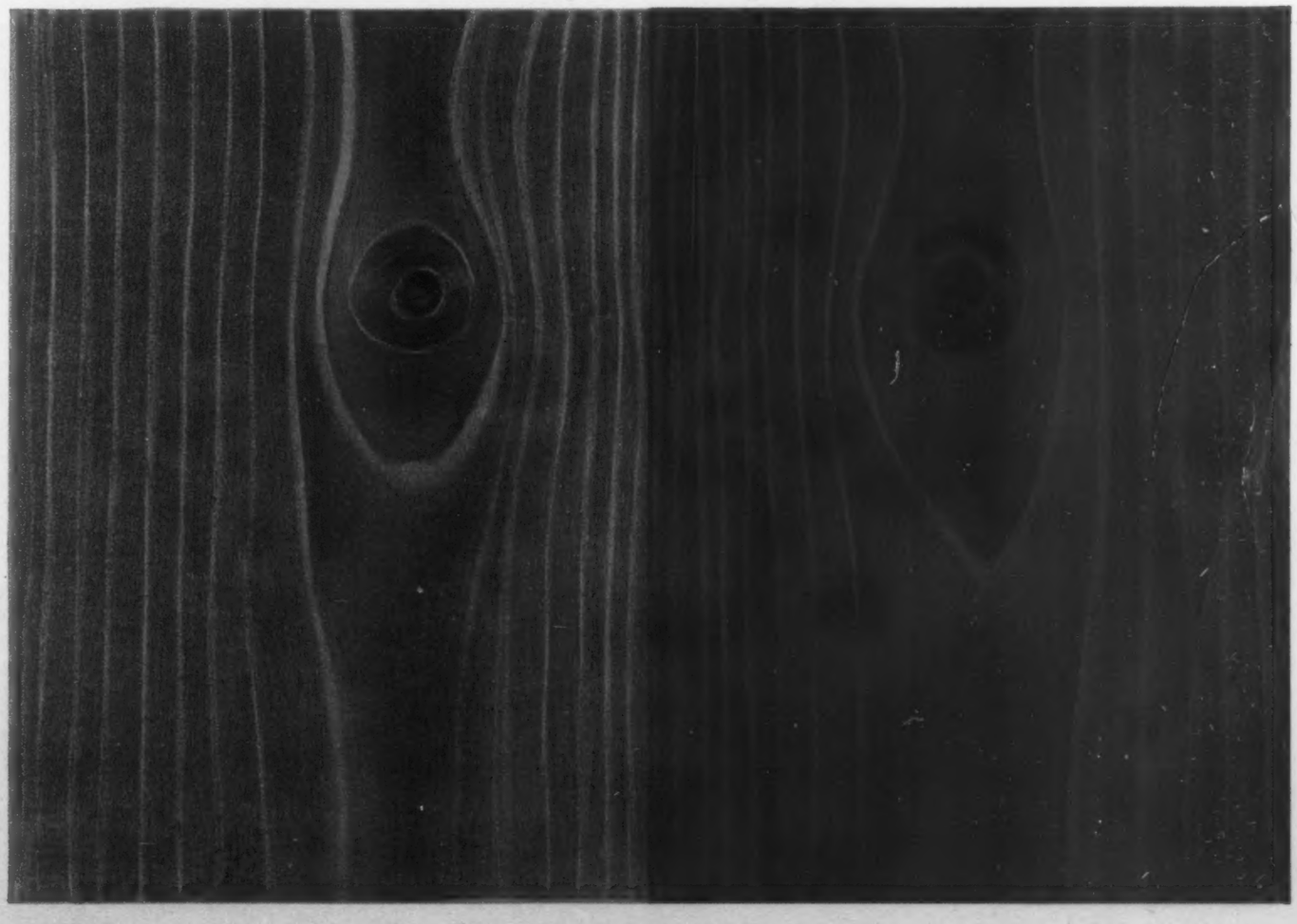
65.—*Pterocarpus dalbergioides.* Padauk. Principal timber tree of Andaman islands. Very large tree. Wood moderately hard. Weight 48 lbs. per cub. ft. Used in Europe and America for pianos, furniture, parquet floors, railway cars, door-frames &c.; in India for gun-carriages. Shrinks very little, does not crack or split, not liable to attack by white ants or dry rot. GAMBLE.

66.—*Gmelina arborea, Linn.* Kullé or Sivané. A deciduous tree found throughout India, Burma and the Andaman Islands. Wood glossy, close and even-grained, soft, light and strong, durable, does not shrink, warp or crack. Weight 30 to 40 lbs. per cubic foot. Easily worked, readily takes paint or varnish; very durable under water. Highly esteemed for planking, furniture, domestic utensils, door panels, carriages and palanquins, well-work, boats, toys, packing-cases, picture-frames, organ pipes, sounding-boards and other such work where shrinkage is to be avoided. Used in Burma for carving images, clogs and canoes. It would probably be a valuable wood for tea-boxes. F. B. MANSON.



67.—*Gmelina arborea, Linn.*

68.—*Aegle Marmelos.* Bel Fruit. A small tree with thorny branches. Not often cut because valued for its fruit. Wood used for pestles of oil and sugar mills, carts & agricultural implements. GAMBLE.



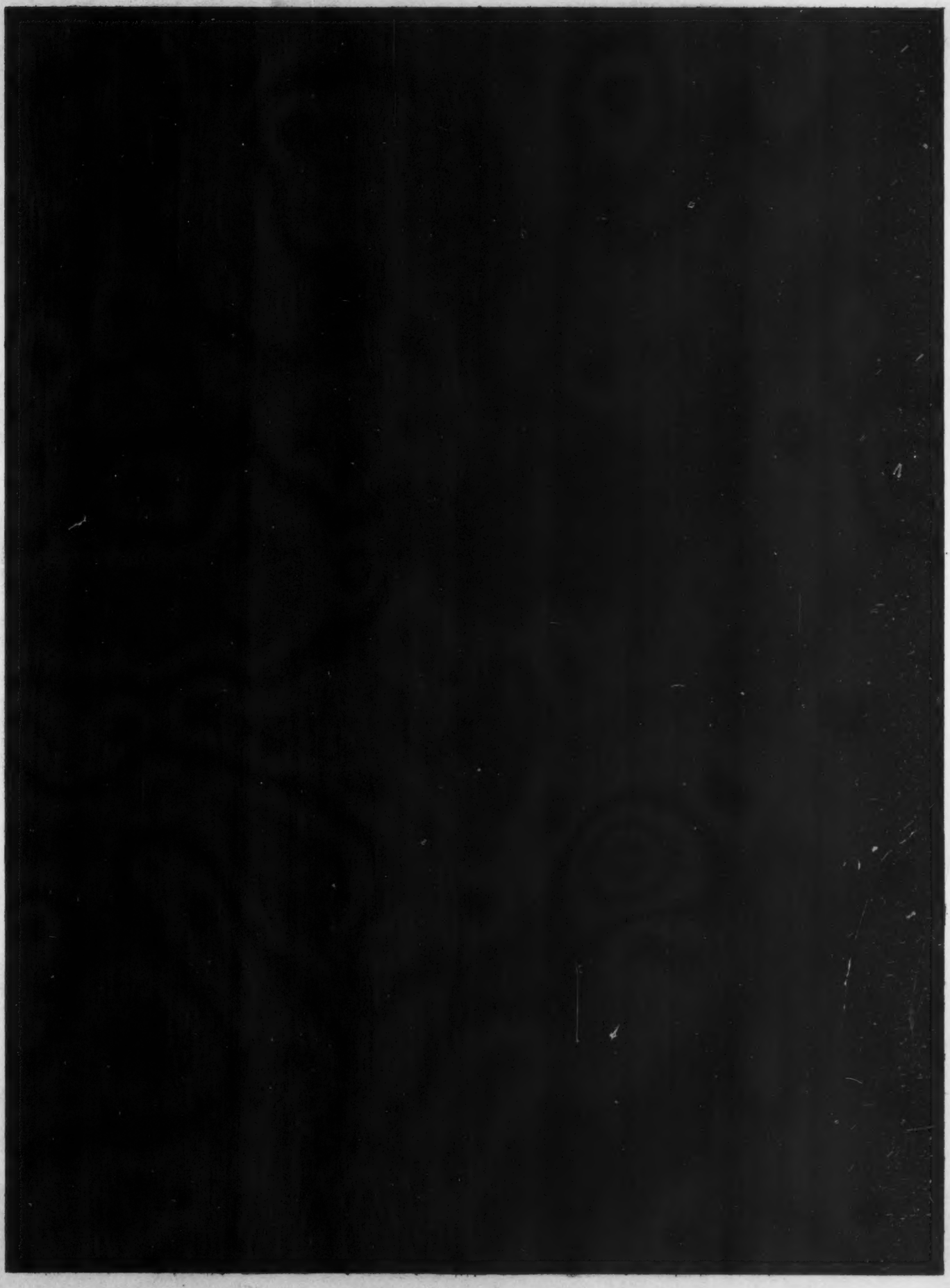
69.—*Mitragyna Parvifolia.* Kaddam or Kein. (=Stephegyne parvifolia). A large deciduous tree, trunk short, often irregularly shaped & buttressed. Bark smooth. Common in both peninsulas, often gregarious, particularly in moist places. Wood used for making combs. BRANDIS.

70.—*Adina cordifolia.* Hardu or Karam. Large deciduous tree. Wood moderately hard. Wt. 45 lbs. per cub. ft. Used for combs, turnery, furniture, agricultural implements, cigar boxes. Liable to warp & crack. GAMBLE.

71.—*Podocarpus neriifolia.* A large evergreen. Wood used for carpentry, oars, spars, masts, tea-boxes. Weight 42 lbs. per cubic foot. GAMBLE.

72.—*Michelia champaca.* Champa. A tall evergreen tree. Wood soft, very durable. Used for planking, door-panels, furniture, canoes, native drains. GAMBLE.

73.—*Careya arborea.* Kumbi. A large deciduous tree. Wood moderately hard, durable; little used, too much neglected. Used for gun-stocks, planking, carts, furniture. Stands well under water. Bark makes good cordage. GAMBLE.



74.—*Hopea parviflora, Bedd.* Kiralabogi. A very handsome tree with small leaves, found in the western moist zone of Malabar and South Kanara, up to 3,500 feet above sea level. When young it has a cone-shaped crown. Wood brown, hard and close-grained, of good quality but little known. Weight about 62 lbs. per cubic foot. It is valued in S. Kanara for building temples, and may be found useful for sleepers. F. B. MANSON.

75.—*Mimusops elengi.* Mulsari or Borsali. A large evergreen. Wood very hard, durable. Wt. about 60 lbs. per cub. ft. Used for building, carts and cabinet work. Makes good fuel. Bark used for native medicine. GAMBLE.

76.—*Planchonia littoralis.* Van Houtte. (=P. valida, Blume) Andaman Baila-Dá. Evergreen. Wood very hard. Weight over 60 lbs. per cubic foot. A valuable wood which should be better known. Seasons well and takes a fine polish. GAMBLE.

77.—*Berrya ammonilla.* Trincomali wood. Wood very hard, but apt to split. Wt. about 50 lbs. per cub. ft. Used for carts, agricultural implements, spear-handles, boats. GAMBLE.

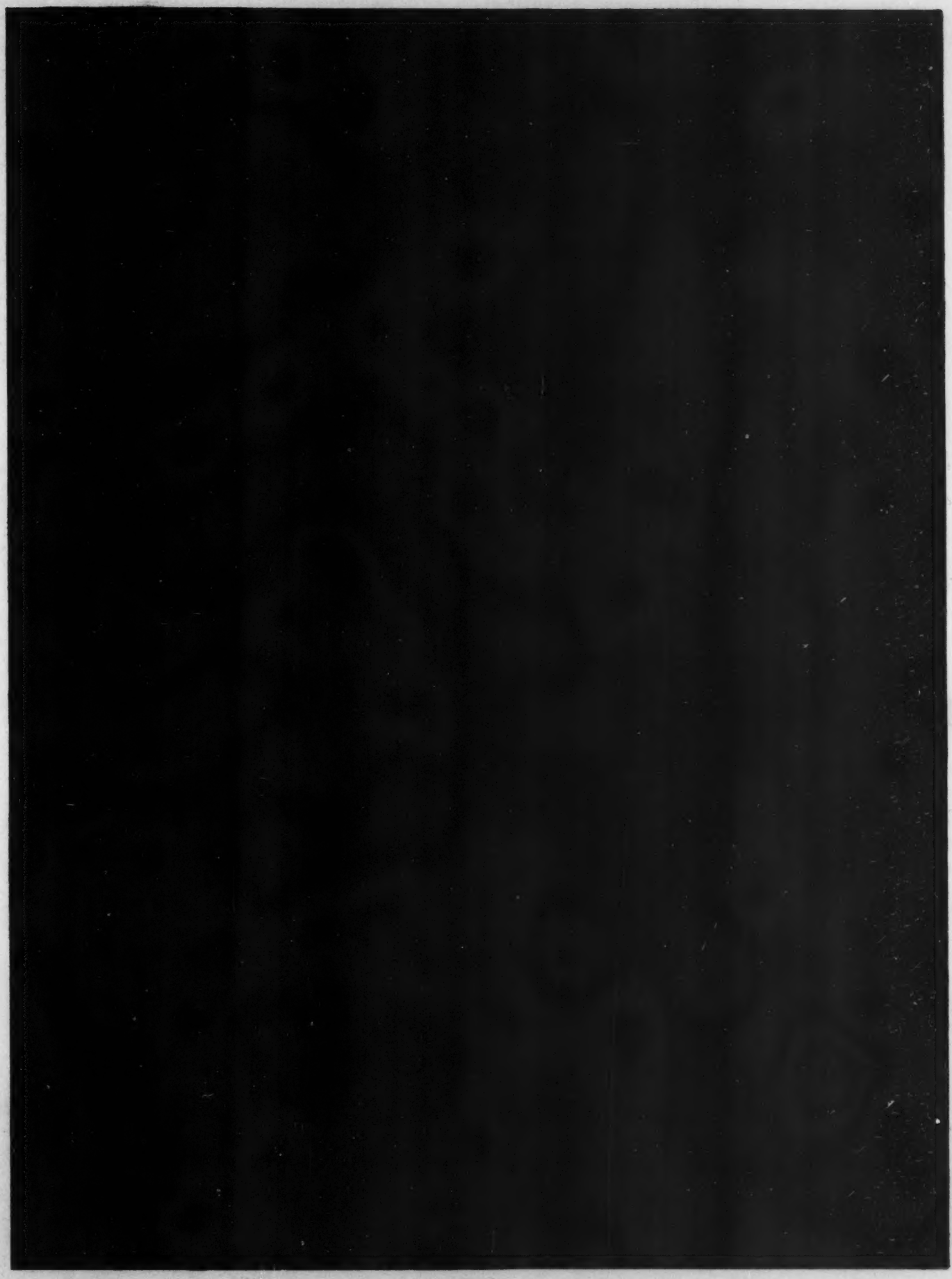
78.—*Adenanthera pavonina.* A deciduous tree. Wood hard. Weight 55 lbs. per cubic foot. Used for building and cabinet-making. Gives a red dye. GAMBLE.

79.—*Xylia dolabriformis.* Ironwood of Pegu. Deciduous. Wood very hard, cross-grained. Wt. 60 lbs. After teak, the most important timber tree of Burma. Used for sleepers, paving-blocks, telegraph poles, boats, agricultural implements, building. GAMBLE.

80.—*Chikrassia tabularis.* Chittagong wood. Wood hard, with satiny lustre. Weight 49 lbs. per cubic foot. Used for furniture. Should be better known. GAMBLE.

81.—*Juglans regia.* Walnut. Large deciduous tree. Wood moderately hard. Wt. 44 lbs. per cub. ft. Used for gun-stocks, furniture, lacquer ware, carvings. GAMBLE.

82.—*Diospyros Melanoxylon.* Coromandel Ebony, Tendu. A deciduous tree. Wood hard, reddish-brown, with an irregular black heart-wood. Weight 75 lbs. per cubic foot. The ebony available is small and not much in demand. Used for combs, picture-frames, etc. GAMBLE.



83.—*Diospyros Ebenum.* Ebony or Balé. A large tree found in the Ghât forests of the Shimoga and Hassan Districts; also plentiful in Ceylon. Wood grey, with irregularly-shaped masses of jet-black ebony near the centre, frequently with lighter-coloured streaks. Weight about 74 lbs. per cubic foot. This is the chief ebony-yielding tree. The wood is exported to England, Germany and China. Used for turnery, cabinet-work, piano-keys, rulers, brush-backs, inlaying, and other ornamental work; in China for chopsticks, pipes, carved vase-stands, etc. GAMBLE.